SEISMIC ZONES REGIONALIZATION of the ARABIAN PENINSULA

النطق الزلزالية في شبه الجزيرة العربية

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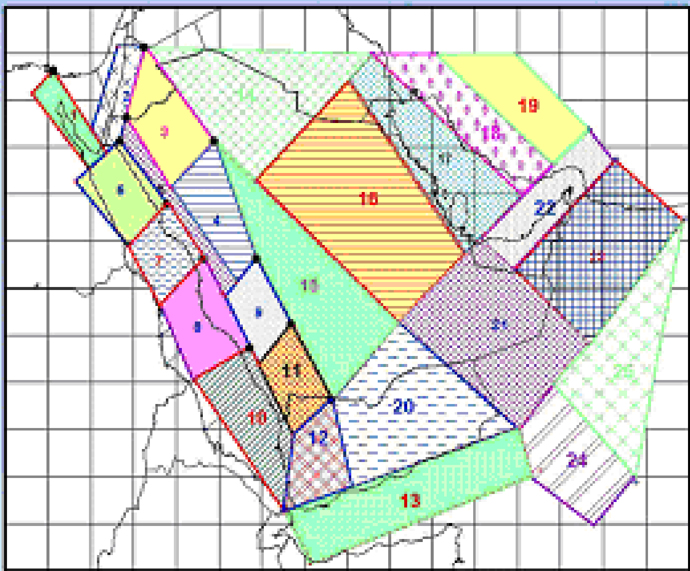
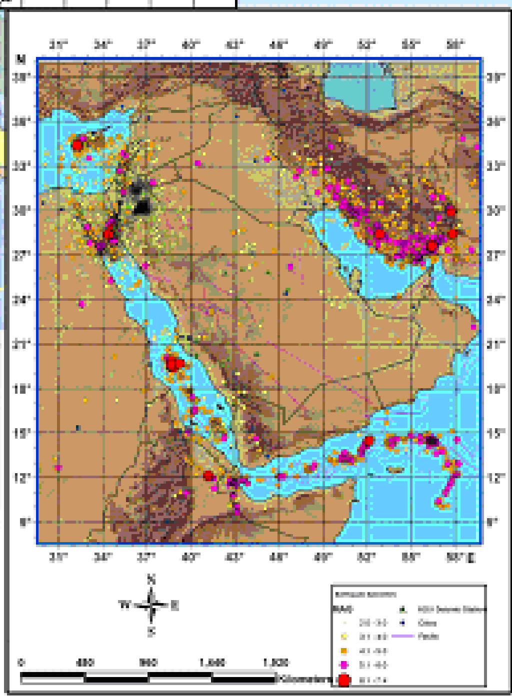
Seismic Zones In The Arabian Peninsula



النطاقات الزلزالية في شبه الجزيرة العربية



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المشرف على مركز الدراسات الزلزالية

جامعة الملك سعود

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النطاقات الزلزالية في شبه الجزيرة العربية

ملخص

تعتبر شبه الجزيرة العربية جزءًا من الصفيحة العربية التي تتحرك نحو الشمال الشرقي نتيجة لإنفراج مركزي البحر الأحمر وخليج عدن واللذان يحددان الصفيحة من الجنوب الغربي. ونجم عن حركة الصفيحة العربية تصادم الصفيحتين العربية والأوراسية على إمتداد نطاقات زاغروس وبيتليس. أما خليج العقبة فيمثل الجزء الجنوبي من نطاق البحر الميت التحولي والذي يمتد لمسافة ١٠٠٠كم تقريبًا والذي يشكل الحد الفاصل بين الصفيحة العربية وسيناء.

وتتركز معظم النشاطات الزلزالية على حدود الصفيحة العربية وبالأخص منطقتي خليج العقبة وجنوب غرب المملكة. وعلى الرغم من قلة النشاط الزلزالي في معظم مناطق المملكه الا أن قربها من المناطق النشطه زلزاليا في ايران وتركيا يتطلب دراسة دقيقة لزلزالية وتحديد مكامن الخطر الزلزالي بدقة عاليه للتقليل من أضرارها مستقبلاً .

هناك ثلاثة شروط يجب توفرها لتحديد إمكانية حدوث الكارثة الزلزالية. الشرط الأول هو كمية القدر الزلزالي حيث أن الأحداث الزلزالية الصغيرة لا ينتج عنها هزات أرضية عنيفة بصورة كاملة وحادة لكي تتسبب في الدمار الشامل. الشرط الثاني هو قرب المصدر الزلزالي. الشرط الثالث هو أن الحدث الزلزالي يعتمد على درجة الإستعداد للكارثة.

لا تعتمد خطورة الزلزال على مدى زلزالية المنطقة أو الإقليم فحسب ولكن أيضًا على الكثافة السكانية والنمو الإقتصادي. فبالرغم من أن الزلزالية تظل ثابتة، فإن الكثافة السكانية والنمو الإقتصادي

يزداد بشكل سريع. ومن أهم العناصر الضرورية للتهيؤ للكوارث هو قابلية التأثير vulnerability أي تخفيف عواقب الزلازل المدمرة. لكي نقوم بتقليل المخاطر الزلزالية بطريقة منطقية فإنه من الضروري الفهم الواضح والإدراك الكامل والتام بالظاهرة الطبيعية المرتبطة بحدوث الزلزال وآثارها الضارة والمدمرة، فالعنصر الأساسي لدرء مخاطر الزلازل هو القدرة على تقييم وتقدير المخاطر الزلزالية بإستخدام حلول منطقية ولكي يتم التعامل مع المخاطر الزلزالية فإنه من الضرورة معرفة ما يلي:

- مصادر الزلازل المدمرة.
- مواقع الأحداث الزلزالية.
- تردد الأحداث الزلزالية المختلفة في الحجم.
- طبيعة الحركة الأرضية بالقرب من مصدر الزلزال أو التوهين مع المسافة.
- تاثير جيولوجية الموقع على شدة الهزة الأرضية.
- أنواع المخاطر الزلزالية.
- الخصائص الرئيسية التي من الممكن أن تعرف مقدار التدمير الناتج عن الهزة الأرضية.

لنمذجة خواص المصادر الزلزالية تم إستخدام طريقتين هما الطريقة الزلزالية وطريقة الكسور. بالنسبة للطريقة الزلزالية تم إستخدام مجموعة من البيانات الزلزالية في كل نطاق وذلك لتحديد وتعيين علاقة القدر الزلزالي – التردد وكذلك لتقدير الإزاحة الخطية السيزمية ومقادير العزم الزلزالي.تم تحديد المعاملات الزلزالية لإيجاد العلاقة بين التراكيب والمصدر الميكانيكي للزلزال.

أما بالنسبة للطريقة الثانية فقد تم فحص وإختيار التراكيب التي يشملها كل نطاق على اساس الخرائط الجيولوجية التكتونية المتوفرة وذلك لمعرفة العلاقة بين أنواع المصدر الميكانيكي للزلزال وزلزالية مصدر المساحة Area source . دلت النتائج على أن هناك نوعين من المصادر بالنسبة

للنموذج التكتوني وهذان النوعان هما المصدر الخطي Line source ومصدر المساحة Area source. بالنسبة للمصدر الخطي يشمل الصدع العرضي Transcurrent والصدوع العادية. أما بالنسبة لمصدر المساحة Area source فهي تشمل الأحداث الزلزالية التي لها علاقة بالفوالق والكسور الصخرية والتي حدث لها إزاحة مما أدى إلى تغير موقعها داخل النطاقات السيزمية.

وبأخذ الاعتبارات الجيولوجية والسيزمية وتطبيق النماذج الرياضية المختلفة تم تحديد ٢٥ نطاق زلزالي وتم تعريفها وتخطيطها في الجزيرة العربية على النحو التالي :

رقم النطاق	أسم النطاق
١	**خليج السويس**
٢	**خليج العقبة – البحر الميت**
٣	**تبوك**
٤	**النطاق البركاني في الشمال الغربي**
٥	**وسط الحجاز**
٦	**ضبا والوجه**
٧	**ينبع**
٨	**جنوب البحر الأحمر – جدة**
٩	**مكة المكرمة**
١٠	**جنوب البحر الأحمر – الدرب**
١١	**أبها – جيزان**
١٢	**جنوب غرب الدرع العربي**

رقم النطاق	أسم النطاق
١٣	**خليج عدن**
١٤	**طريف – وادي السرحان**
١٥	**صدع نجد**
١٦	**منخفض وسط المسطح العربي**
١٧	**الخيج العربي**
١٨	**جبال زاجروس**
١٩	**سلسلة سنتداج إيران**
٢٠	**جنوب اليمن**
٢١	**حوض الربع الخالي**
٢٢	**ديبا – بندر عباس**
٢٣	**مكران – حواسنة**
٢٤	**مرتفعات شرق شيبه**
٢٥	**صدع المسيره**

إعتبرت نطاقات المصادر الزلزالية ١ و٢ و٦ و٨ و١٠ و١٣ و١٨ و١٩ و٢٢ و٢٤ مناطق نشطة زلزالياً خلال الفترات التاريخية والحديثة . تتميز نطاقات المصادر الزلزالية هذه بوجود واحد أو أثنين من ميكانيكيات المصادر المحتملة مثل نظم الصدع (rift) وصدوع عمودية وإنزلاقية ونطاقات تصادمية .

التوزيع الفراغي والزمني للأحداث الزلزالية في نظام الصدع تبدو كثيفة ولكن يوجد تشوه قشري عبر محور الصدع (rift) بينما مواقع البؤر الزلزالية في منطاق الـتصادم تعتبر تقريباً منتظمة التوزيع . وتتراوح قيمة الـــ b لهذه المناطق الزلزالية بين ٠.٧ و ١.٢ .

ويلاحظ أن باقي مناطق المصدر الزلزالي تعتبر غير نشطة زلزالياً من حيث وقوع أحداث زلزالية ضعيفة إلى متوسطة خلال الفترات التاريخية والحديثة بالرغم من أن بعض نطاقات المصدر الزلزالي هذه (١٦ و١٥ و١٢ و ٩ و٧ و ٥ و٤) تحتوي على نظام صدع معروف وتقع في منطقة بركانية . وتتراوح قيمة الـ b في مناطق المصدر الزلزالي هذه تقريبا من ٠.٣٥ – ٠.٦ ماعدا المناطق البركانية التي يبدو أنها تتبع نظام الصدع rift.

ABSTRACT

The Arabian Peninsula presents several interesting seismological problems. On the west, rifling in the Red Sea has split a large Precambrian Shield. Active rifling is responsible for the geometry of the plate margins in the west, and southwest. To the south, similar rifling running in a more east-west direction through the Gulf of Aden has separated the Arabian Peninsula from Africa. In the northwest, the Gulf of Aqabah forms the southernmost continuation of the Dead Sea transform. The northern and northeastern boundaries of the Arabian Plate are areas of continental collision, with the Arabian Plate colliding with the Persian Plate.

Earthquake hazard depends not only on the seismicity of a region, but also on population density and economic development. Even though seismicity remains constant, both population and economic development are increasing rapidly. Identifying sources of vulnerability and taking steps to mitigate the consequences of future earthquake disaster are the most essential elements of disaster preparedness. Because the existing facilities represent the main earthquake risk, research and performance evaluation have much desire to be done in this critical area.

In order to reduce earthquake hazards in a rational way, it is necessary to have a clear understanding of the phenomena associated with earthquakes and their adverse effects. The key element in coping with earthquake hazard is the ability to assess seismic hazard. To make rational decisions in coping with earthquakes, it is necessary to know the answers to some questions related to:

- **Sources of destructive earthquakes**
- **Locations of earthquake occurrences**
- **Frequency of various size of earthquakes**
- **Nature of the severe ground motion near the source and its attenuation with distance**
- **Influence of local geology and site condition on the severity of ground shaking**

- **Types of earthquake hazards**
- **Main characteristics that define the damage potential of earthquake shaking**

The activities in the seismic regionalization of the Arabian Peninsula was partitioned and conducted into two primary stages. These are the identification and delineation of the seismogenic source zones and determination of the seismicity and other related parameters of seismic concern. In the identification and delineation of the seismogenic source areas, some criteria were followed and utilized as guidelines. These are mainly the seismological and geological parameters, and to lesser extent is the consideration of the geophysical parameters when needed. The seismological parameter is chiefly composed of the planar spatio-temporal distribution of earthquakes that indicates both seismogenic provinces and seismo-active faults, and occurrences of large earthquakes, the level of which depends upon the seismic activity in the region. The geological parameter is primarily a map of regional tectonics that shows the location of joints, faults, lineaments, and rift systems that are associated with the seismic activities in the area. In reference to these two parameters as criteria and guidelines, the boundaries of each seismogenic source zone are drawn in such a way that a cluster or more clusters of earthquakes are included and traversed the region of minimum density of epicenters, but do not intersect the main tectonic provinces. From these considerations, there are a total of twenty five (25) seismogenic source zones that were identified and delineated for the western and eastern Arabian Peninsula. Numerically arranged and namely described as follows:

Zone Number	Zone Name
1	Gulf of Suez
2	Gulf of Aqabah-Dead Sea System

3	Tabuk Region
4	Northwestern Volcanic Zone
5	Midyan-Hijaz Region
6	Duba-Wajh Area
7	Yanbu Area
8	Southern Red Sea-Jeddah Area
9	Makkah Area
10	Southern Red Sea-Al Darb System
11	Abha-Jizan Area
12	Southwestern Arabian Shield
13	Gulf of Aden
14	Sirhan-Turayf-Widyan Basins
15	Najd Fault Zone
16	Central Arabian Graben Zone
17	Arabian Gulf
18	Zagros Fold Zone
19	Sanandaj-Sirjan Ranges
20	Eastern Yemen
21	Rub Al Khali-Ghudun Basins
22	Dibba-Bandar Abbas Region
23	Hawasina-Makran Thrust Region
24	East Sheba Ridge System
25	Masirah Fault System

The seismic source zone characterization scheme for the different source areas is also composed of two fundamental aspects. These are the seismicity and tectonic aspect in each seismogenic source zone. The description and characterization for the seismicity aspect requires the statistical and deterministic analysis of the seismic activity in each source area. Henceforth, the required seismic data are collected and compiled separately for each identified seismic zone.

In general, the seismic source zones (1, 2, 6, 8, 10, 13, 18, 19, 22, 24) can be considered as seismogenically active within the period of observation. These seismogenic source zones are characterized by the presence of one or two of the probable source mechanisms such as rift systems, strike-slip/normal faults, subduction and collision zones. The spatio-temporal distribution of seismic events in the rift systems shows intense but scattered crustal deformation taking place along the axial rift, while epicenters location in subduction and collision zones are more or less uniformly distributed. The b-values for these seismic source areas range from 0.7-1.2. The other seismogenic source zones are observed to be seismically inactive in terms of moderate to strong earthquake events within the duration of the period of observation, although some of these seismic source zones (16, 15, 12, 9, 7, 5, 4) contained prominent fault systems and or located in volcanic areas. The b-values found for these seismic source areas range approximately from 0.35-0.6, except for volcanic areas which seemed to be affiliated to rift systems.

INTRODUCTION

Modern societies and economics depend upon engineered infrastructures supplying externally supplies such as power for their continued successful operation. The supplies and services enable development and growth to proceed and progress. The administration and distribution of the supplies and services are the means by which society operates on a daily basis, and without which the infrastructures of the region would be adversely affected, economically, socially, and politically.

In the foreseeable future, there will be rapid growth of industrial development, increased population, and urban expansion. Experience has demonstrated that natural disaster, and earthquakes in particular have tended to become increasingly destructive since these affect a larger concentration of national properties and population, thus, generating calamitous incidents like the Cairo earthquake: 12 Oct 1992; Yemen earthquake: 28 Dec 1982; Aqabah earthquake: 22 Nov 1995 and Bam earthquake Dec. 2003.

Particularly, three conditions determine the occurrence of an earthquake disaster. The first condition is the magnitude of the earthquake since small seismic events will not sufficiently generate severe ground shaking to cause extensive damage. The second condition is the closeness of the source of earthquakes, but under special conditions, earthquake disaster can occur at further distance (450 km). The third condition is dependent on the degree of earthquake preparedness.

The compiled seismic data are treated in accordance to the requirements of the methods of analysis that are intended to be applied in the attainment of the goals of the study. Firstly, the seismic data for the observation period from 112AD up to 2003 were compiled for the western and southern part of Saudi Arabia from different sources : the USGS from the period (1963-2003), IPRG from the period (1927-1999), and from Ambraseys (1988) is the period

(112AD-1964). The compiled seismic data set is subdivided into two (2) periods of observation. These are the historical (112AD-1964) and the instrumental (1965-2003 AD).

In the eastern part of the Arabian Peninsula, the seismic data were compiled for the period 112AD-2003. The seismic data sources are the USGS from 1963-2003, KNSN for the period 1999-2003, and Ambraseys (1988) for the period 112AD-1964. Other alternative sources for the whole seismic data of the Arabian Peninsula that were referred too are the ISC for the period 1965-2000 and EMSC from 1996-1999. For the eastern part of the Arabian Peninsula, the compiled seismic data were also subdivided into two (2) periods of observation. These are the historical (112AD-1964) and instrumental (1965-2003).

Due to the conglomeration of the gathered, collected, and compiled seismic data from the different seismic bulletins, it is necessary and essential that the appropriate and quality data that are required in the seismic regionalization scheme must be utilized. To ensure the quality and reliability of results, the accumulated data files for the western and eastern Arabian Peninsula have undergone data treatment such as follows:

- ❖ Non-duplication – separation of two or more seismic events should have 25 seconds difference in origin time, and for repetitive events, the USGS file is given preference in the selection.
- ❖ Reduction of cluster events- three procedures in the reduction of cluster events which may be composed of foreshocks, aftershocks, and swarms types can be referred for this treatment. These are from Gardner & Knopoff (1974), Utsu-Seki and Omori aftershocks equations, and the eye fitted test of the relation logN=a-bM which is preferably used in the study.
- ❖ Completeness of seismic data- incompleteness of seismic data cannot be avoided. The more you moved back in time, the less satisfactory it becomes. Several factors are involved in this process. These are absence, insufficiency, and low detection

capability of instrumentation, scarcity and inadequacy of physical factors involved in macroseismic observations, and lack of appropriate conversion equations from one set of seismic parameter to another. Reliability may range from 0.2-0.5 degree in distance, 0.5 in magnitude, and one degree scale in intensity are possible to attain in the procedure of completion.

- ❖ Missing magnitudes – are not included for there are no adequate and sufficient information regarding the occurrences of these seismic events.

The second stage which is the determination of the seismicity and other related parameters requires the application of statistical, probability, and deterministic concepts. The applied statistical methods to the treated compiled seismic data for the description and quantification of the seismic activity, and its correlation to the tectonic structures and probable source mechanisms in each source area are discussed in detail.

Most regions that are threatened with earthquake hazards have conducted seismic hazard assessment through zoning maps with different seismic hazard level. Because each zone covers large area, the present map represents a crude average of the real seismic hazard in each zone.

1. REGIONAL TECTONICS

The surface geological and tectonic settings of the Arabian Peninsula consist mainly of :

- **The Arabian shield in the west and**
- **The Arabian platform in the east.**
- **Tertiary volcanism along the Red Sea coast**
- **Red Sea & Gulf of Aqabah**

1. 1 The Arabian Shield

The accretionary evolution of the Arabian plate is thought to have originated and formed by amalgation of five Precambrian terranes. These are the Asir; Hijaz, and Midyan terranes from the western part of the Arabian shield, and from the eastern side of the shield are the Afif terrane and the Amar arc of the Ar Rayn micro-plate. The western fusion is along the Bir Umq and Yanbu sutures (Loosveld et al 1996). The eastern accretion may have started by about 680-640 million years ago (Ma) when the Afif terrane collided with the western shield along the Nabitah suture. At about 670 Ma, a subduction complex formed west of Amar arc. Along this subduction zone, the Afif terrane and Ar Rayn microplate collided that lasted from about 640-620 Ma. (Al-Husseini 2000). The north trending Rayn anticlines and conjugate northwest and northeast fractures and faults may have formed at this time (Figs 1-3).

The Arabian Shield is an ancient land mass with a trapezoidal shape and area of about 770,000 sq. km.(Fig. 1). Its slightly-arched surface is a peneplain sloping very gently toward the north, northeast, and east. The framework of the shield is composed of Precambrian rocks and metamorphosed sedimentary and intruded by granites. The fold-fault pattern of the shield, together with some stratigraphic relationships suggests that the shield have undergone two

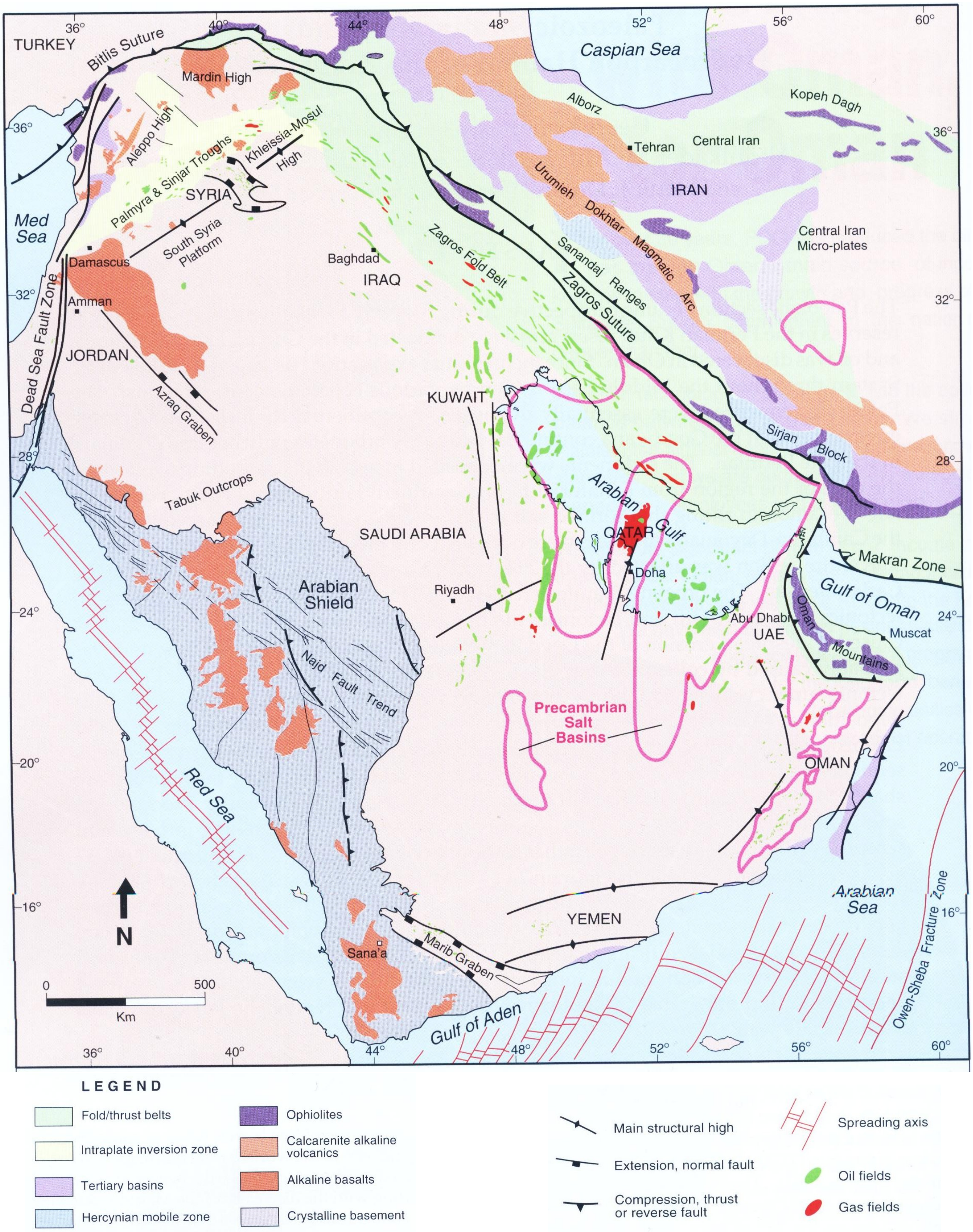


Fig. 1: Location and major tectonic elements of the Arabian plate and Iran. The Makran and Zagros separate the Arabian plate from the microplates of interior Iran.

orogenic cycles. The first cycle was the Al Hijaz orogeny which was more intense and widespread areally. East-west compression was dominant, so that strongly folded and faulted beds of the shield in the west-central part trend northeasterly, while in the southern portion trend generally northerly. The tectonic features include transcurrent, normal and high angle reverse faults, and major fold axes. For the first orogeny, folding and intrusion may have occurred at greater depth. The second cycle was the Al Najd orogeny. This orogeny represents the younger period of mountain building. The effects of the second orogeny were the northwesterly trending left lateral faults. The faults may reflect shearing from shallower movements. The fault systems in this orogeny are subsequent to the other systems and have offset and truncated many of the previous tectonic lineaments. It is one of the most prominent Precambrian Cambrian sinistral wrench fault systems (Chapman 1978).

Following the formation of the Najd fault system, the Arabian shield remained a rather stable platform throughout the Paleozoic and Mesozoic except for several episodes of movement along older faults. The only major orogenic event which affected the region since early Cambrian was the deformation and magmatism associated with the Red Sea rifting. Recently, various speculations have indicated that the Arabian-Nubian shield formed through a process of arc and micro-plate accretion. On the basis of this interpretation, the evolution of the Arabian shield is in terms of 3 stages: (a) magmatic arc; (b) continental collision; (c) intra-cratonic.

To the first order, the Arabian shield is composed of two layers, each about 20km thick, with average velocities of about 6.3 km/s and 7 km/s respectively (Mooney et al 1985). The crust thins rapidly to less than 20 km total thickness at the western shield margin, beyond which the sediments of the Red Sea shelf and coastal plain are underlain by oceanic crust.

1.2 Arabian Platform

The platform consists of the Paleozoic and Mesozoic sedimentary rocks that unconformably overlays the shield and dip very gently and uniformly to the E-NE towards the Arabian Gulf (Powers et al., 1966). The accumulated sediments in the Arabian platform represent the southeastern part of the vast Middle east basin that extend eastward into Iran, westward into the eastern Mediterranean and northward into Jordan, Iraq and Syria.

The Arabian shield isolated the Arabian platform from the north African Tethys and played an active paleogeographic role through gentle subsidence of its northern and eastern sectors during the Phanerozoic, allowing almost 5000 m of continental and marine sediments deposited over the platform. This accumulation of sediments represents several cycles from the Cambrian onward, now forms a homocline dipping very gently away from the Arabian shield.

Several structural provinces can be identified within the Arabian platform : 1) An interior homocline in the form of a belt, about 400 km wide, in which the sedimentary rocks dip very gently away from the shield outcrops. 2) An interior platform, up to 400 km wide, within which the sedimentary rocks continue to dip regionally away from the shield at low angles. 3) Intra-shelf depressions, found mainly around the interior homocline and interior platform (Fig. 2).

Unfortunately, no locally recorded earthquake data have been used to determine the crustal characteristics of the Arabian platform. The regularly spaced north trending Summan platform, Khurais-Burgan and En Nala-Ghawar anticlines, and Qatar arch in the eastern part of the Arabian plate appear to have formed during the Precambrian Amar Collision about 640-620 million years ago (Ma). This collision occurred along the north trending Amar suture that bisects the Arabian peninsula at about 45 degrees east longitude when the Rayn microplate in the east was fused to the western part of the Arabian craton (Al-Husseini 2000 ; Looseveld et al 1996). The great anticlines are bounded by the northeast trending Wadi Batin fault and northwest trending Abu Jifan fault that converge on the Amar suture. The anticlines intersected deformed metasediments that are dated as syn-collisional. The Amar collision was followed by a widespread extensional collapse of the Arabian-Nubian shield between about 620-530 Ma. The extensional collapse culminated in the regional development of the extensive Najd fault and its complimentary rift basins, Zagros suture, the northeast trending Oman salt basins, Dibba fault, and the Sinai triple junction.

The Sinai triple junction is composed of the Najd fault system, the Egypt rift, the Jordan valley, and Derik rift. During the final extensional stage about 530-570 Ma, the northwest trending Najd fault system dislocated the Arabian shield left-laterally by about 250-300 kilometers. This dislocation appears to compliment the northeast oriented intra-continental rifts in Oman, Zagros mountain, and the Arabian gulf. These rift basins accumulated thick sequences of clastic and carbonate rocks and salt such as the Ara group in Oman, Hormuz series in the Arabian gulf and Zagros mountain (Ziegler 2001). During the extensional collapse, the north trending anticlines probably remained elevated as elongated horst bounded by normal faults. The intervening subsiding grabens accumulated syn-rift sediments including the Hormuz salt, and form an inter-fingering pattern between the great north trending anti-clines.

The striking geometric pattern appears to have formed in two tectonic stages. The Precambtian Amar collision between about 640-620 Ma, followed by the development of the Najd rift system between about 570-530 Ma.

In Oman, during the intra-extensional tectonics (rift cycle 1), a series of north-south to northeast –southwest trending basement highs may have developed from north to south. These are the Ghudun-Khasfah high, the Anzaus-Rudhwan Ridge and the Makarem-Mabrouk

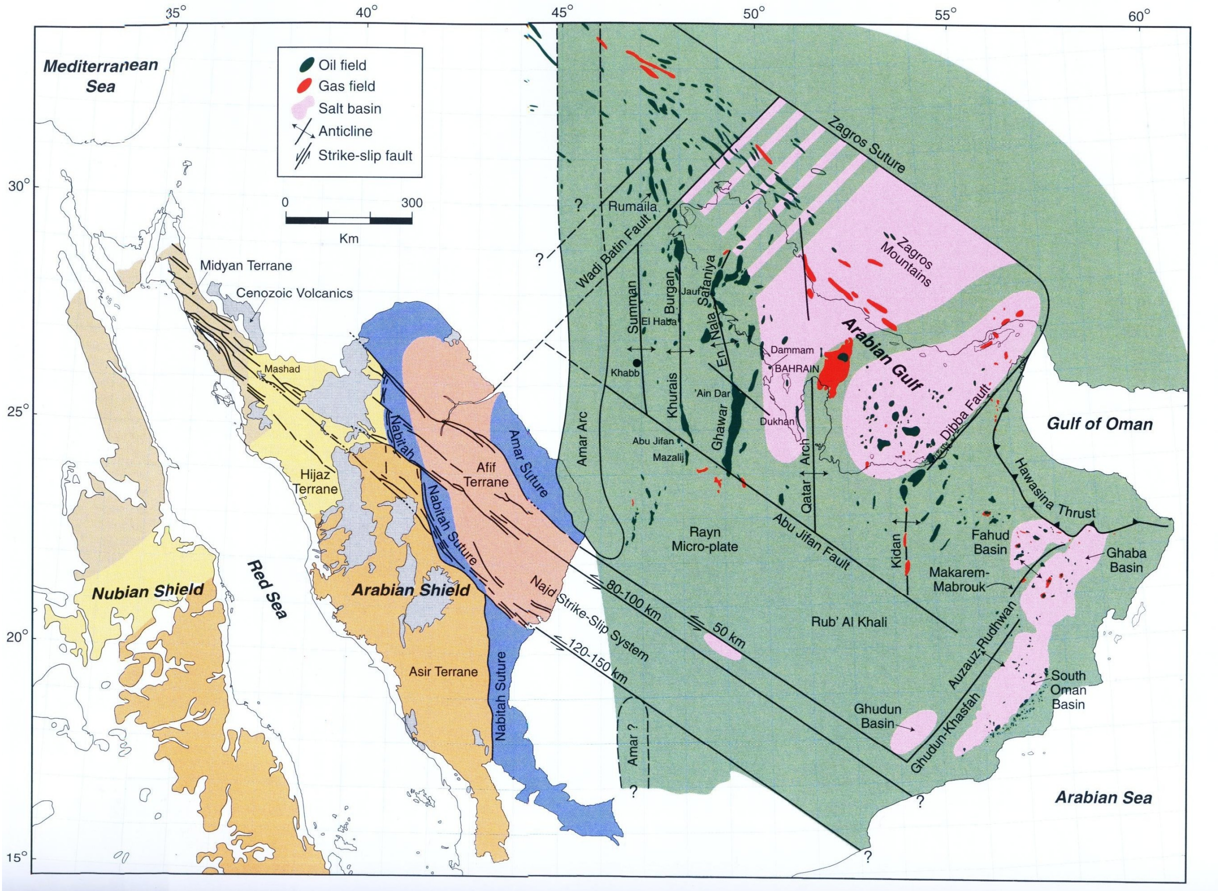


Fig. 2 : The terranes, and Amar Arc of the Rayn micro-plate. The Rayn micro-plate (Green) forms the eastern part of the Arabian Plate (Al-Husseini, 2000).

high, separating different basin segments. The event is also associated with igneous activity which is the formation of the Oman mountains and is followed by a thermal subsidence phase. During this cycle, there may have been widespread rifting of the Abu Mahara group (During the Cambrian to mid-Carboniferous (Rift Cycle 2), the Abu Mahara rift configuration was reactivated. The re-activated eastern angle low-angle bounding fault of the Ghudun-Khasfah high becomes the western margin of the asymmetrical South Oman basin. In the north, the Ghaba salt basin develops as a narrower, deeper and asymmetrical feature with some asymmetry reversals. The South Oman and Ghaba salt basins are related to the Najd event of rifting and wrenching dated at between 600-540 Ma (Looseveld et al.,1996). Around 110 Ma, the Atlantic ocean started to open, leading to the closure of the Neo-Tethys between the Afro-Arabian and Eurasian plates. A northeasterly dipping intra-oceanic subduction zone developed, accompanied by back-arc spreading. At approximately 93 Ma, this subduction complex collided with the continental crust of Oman. Uplift and partial erosion of the Natih formation and the development of a major hard ground signaled the onset of this event. The initial onset has been described as a mobile or stationary fore-bulge that preceded down-warping of the foreland ahead of the advancing thrust front. During this phase, the Hawasina and Samail Nappes are emplaced, the region south of the nappes are downwarped with local footwall uplift, the Aruma foredeep develops, a dextral transtension along the Fahud fault zone, and a sinistral transtension along the Maradi fault zone occur. In the Eocene-Pliocene second Alpine phase, folding commences in the Oman mountains and shortening overprints extension in the area around Natih, Fahud, and the northern Maradi fault zone (Noweir & Asharhan 2000). The Salakh arch develops, reverse faulting occur in foredeep, the northern portion of the Maradi fault zone is inverted in dextral transpression, and the Fahud main fault is re-activated with a small sinistral component.

At the Cretaceous-Tertiary boundary, intra-oceanic north-over-south thrusting between the lower and upper nappes of Masirah island occurred, immediately followed in the Paleocene by the oblique obduction of the Masirah complex onto the Arabian continent (Peters et al 1995). Along the east coast of Oman, largely offshore under Masirah bay and Sawqrah bay, a narrow, gently folded foreland basin, the Masirah trough, developed. The western margin is bounded by normal faults reactivating Mesozoic rift related faults. On its eastern margin, a wedge of ophiolitic and probably continental slope sediments is largely underthrusted below the eastern and uplifted part of this foredeep basin.

1. 3 Tertiary Volcanism

Two distinct phases of continental magmatism are evident in western Saudi Arabia. The first phase produced tholeiitic-to-transitional lavas emplaced along NW trends from about 30 to 20 Ma. The second phase produced transitional-to-strongly alkalic lavas emplaced along NS trends about 12 Ma to Recent. The first phase is attributed to passive-mantle upwelling during extension of the Red Sea Basin, whereas the second phase is attributed to active mantle upwelling but was facilitated by minor continental extension perpendicular to plate collision (Camp & Roobol, 1992). The second phase is largely contemporaneous with a major period of crustal uplift to produce the West Arabian swell. The central axis of the uplift and magmatism of the Arabian swell is symmetric and coincides with two fundamental features which are the Ha'il-Ruthbah Arch in the north and the Makkah-Madinah-Nafud volcanic line in the south (Camp & Roobol, 1992). Volcanism was widespread in western Saudi Arabia during the Tertiary Period. The oldest lavas, called the Trap Series rest on Cretaceous clastics in Yemen where these are associated closely with the Rifting of the Red Sea. Northward, thick effusions of basalt and andesite cover vast areas. The effusions have been subdivided on the basis of radioactive dating, and these ranges from Oligocene to Holocene. The Oligocene and Holocene flows were like those of the Trap Series. Thus, volcanism continued up to the present time (Chapman 1978).

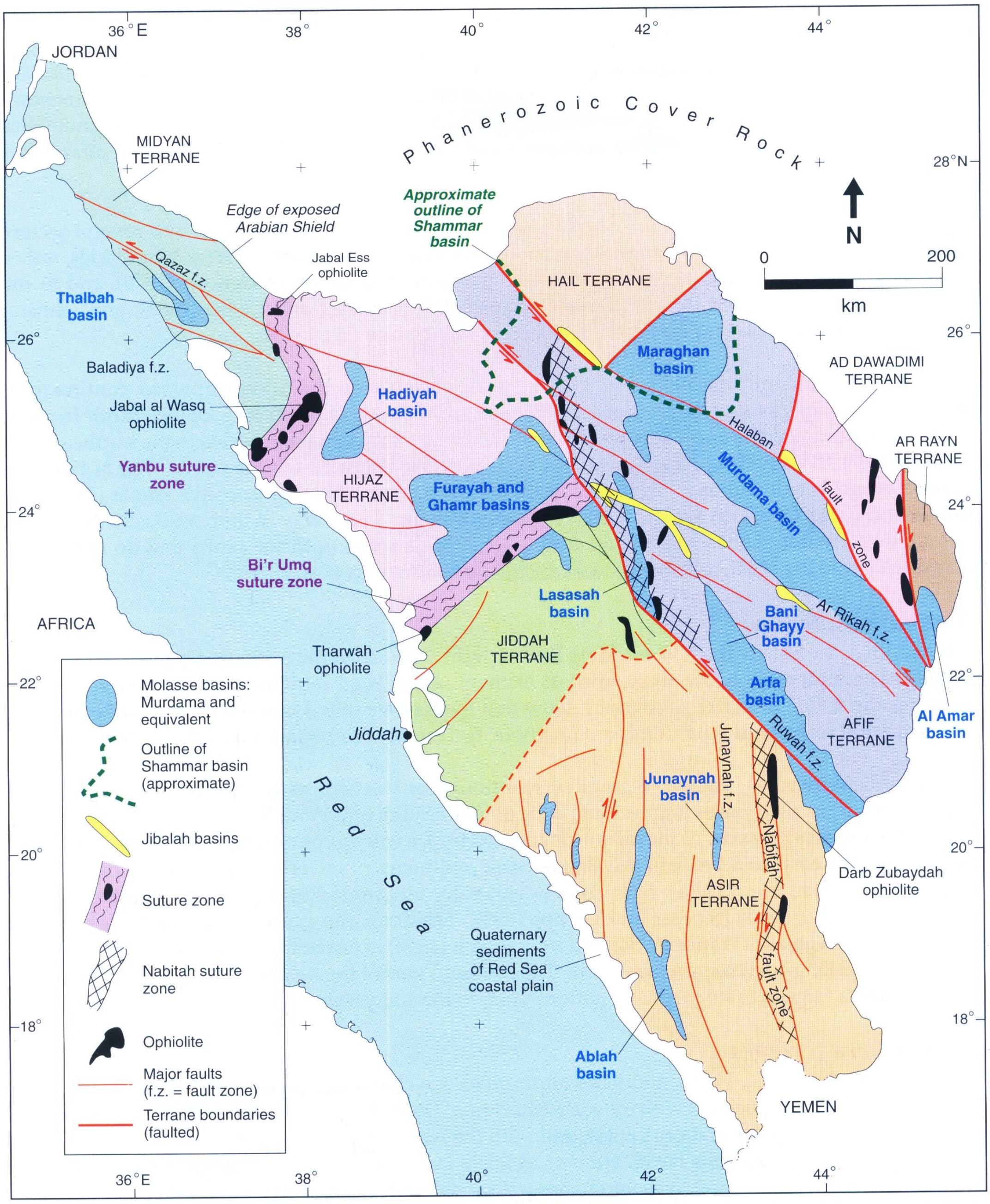


Figure 3: Simplified geologic sketch map of the Arabian Shield showing the terranes and their boundaries, and the main Pan-African structural features and sedimentary basins. Major fault zones, such as Ruwah, Ar Rikah, Halaban, and Qazaz, belong to the Najd fault system.

1. 4 The Red Sea and Gulf of Aqabah

The Red Sea is an 1800 km elongated trough trending NW-SE from the Sinai Peninsula in the north down to the Strait of Bab Al Mandeb in the south. The Red Sea can be divided into two main physiographic units. These are: (a) the shelf area which is composed of the coastal area and the marginal shelves, (b) the main and axial trough. The shelf is narrow in the north and wide in the south, whereas the trough is wide in the north and narrow in the south.

Structurally, the Red Sea is a graben along the crest of an anticline that formed in the Arabian-African Shield. The inner margins of the shield apparently undergo considerable uplift that formed prominent scarps at the edge of the Red Sea rift. A zone of 1-2 km. wide that is composed of high and tensional faults concealed by coastal sediments lies at the foot of the escarpments. On the seaward side of this zone, the basement has been step faulted downward in blocks and lies beneath the shelf area at depth of 2-3 km below sea level (Chapman 1978).

Three sets of faults seem to have controlled the development of the Red Sea. These were the NW-SE trending main line of faults which are associated with step faulting and the WNW-ESE major fault trend in the Precambrian basement which caused many irregularities in the coastline (Chapman 1978).

The regional distribution of seismicity in the Red Sea indicates concentrated distribution of events proximal to the main and axial trough in the southern portion. However, the concentration is not uniformly distributed, but occurs in clusters on the ridge crests, or near transform faults of the rift axis. Other significant activities appear to occur along other portions of the central rift not having transform faults. The activities may be related to intrusive mechanism, normal fault movements associated with the down dropping of blocks, or movements along undetected transform faults. Focal mechanisms for two earthquakes located near the southern Red Sea rift axis indicate nearly pure strike-slip mechanism on NE trending planes that suggest seismic activity on rift transform faults.

The Gulf of Aqabah forms the southern part of the Levantine transform fault. This fault forms the boundary between the Arabian and African plates. The fault is composed of 4 straight segments. The first is along the Aqabah and Araba that trends N15E, the second runs along the Dead Sea, Jordan and Hula Valley, the third passes through the Beka'a and Orontes valley, and from Orontes the transform extends up to the Taurus-Zagros thrust. With a total of 105-110km dominant left lateral shear, minor components of extension, compression and up-warping occur in many places. Normal faults were generated along the margins of the transform due to these systems with variable displacements in the localities of these faults. Changes in the trend of the transform resulted in the formation of rhomb-shaped basins such as the 4 deeps in the gulf and the Dead Sea. On either side of the gulf, long early Neogene dykes trending NW parallel to each other were believed to have accompanied the initial rifting of the Red Sea. This volcanism was followed by the shear along the Gulf of Aqabah. A system of faults sub-parallel to the gulf exists within a zone of tens of kilometers wide on either side. From a study of active faulting in the Dead Sea rift, Al-Amri et al. (1991) indicated that there two types of fault activities. These are the strike-slip and normal, faults, the previous type as the more prominent in activity.

2. SEISMICITY & CRUSTAL STRUCTURES

2.1 Seismicity

The Arabian Peninsula forms a single tectonic plate, the Arabian Plate. It is surrounded on all sides by active plate boundaries as evidenced by earthquake locations. Figure 4 shows a map of the Arabian Peninsula along with major tectonic features and earthquake locations. Active tectonics of the region is dominated by the collision of the Arabian Plate with the Eurasian Plate along the Zagros and Bitlis Thrust systems, rifting and seafloor spreading in the Red Sea and Gulf of Aden. Strike-slip faulting occurs along the Gulf of Aqabah and Dead Sea Transform fault systems. The great number of earthquakes in the Gulf of Aqabah pose a significant seismic hazard to Saudi Arabia. Large earthquakes in the Zagros Mountains of southern Iran may lead to long-period ground motion in eastern Saudi Arabia.

The two large regions associated with the presence or absence of sedimentary cover define the large-scale geologic structure of the Arabian Peninsula. The Arabian Platform (eastern Arabia) is covered by sediments that thicken toward the Arabian Gulf. The Arabian Shield is has no appreciable sedimentary cover with many outcrops. The Arabian Shield consists of at least five Precambrian terranes separated by suture zones (*Schmidt et al.*, 1979). During the late Oligocene and early Miocene, the Arabian Shield was disrupted by the development of the Red Sea and Gulf of Aden rifts, and from the mid-Miocene to the present, the region experienced volcanism and uplift (*Bohannon et al.,* 1989). The uplift and volcanism are generally assumed to be the result of hot, buoyant material in the upper mantle that may have eroded the base of the lithosphere (*Camp and Roobol*, 1992). However details about the nature of the upper mantle, such as its thermal and compositional state, are not known. Volcanic activity (the Harrats) is observed on the Arabian

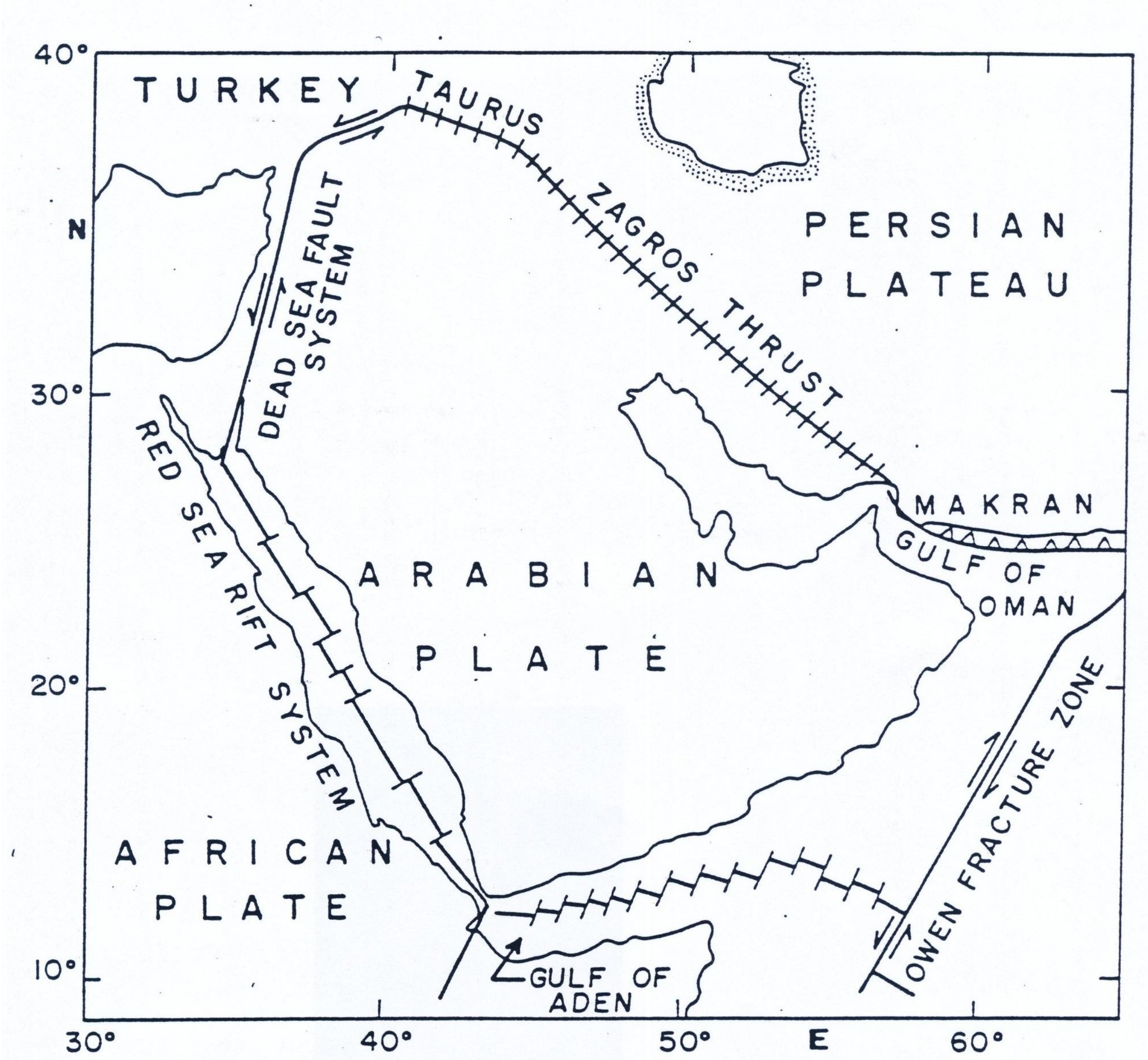


Fig. 4. Plate Boundaries of the Arabian Peninsula

Shield . This is likely to be related to the opening of the Red Sea and mantle asthenospheric upwelling beneath western Arabia (e.g. *Camp and Roobol*, 1992).

The northwestern regions of Saudi Arabia are distinct from the Arabian Shield, as this region is characterized by high seismicity in the Gulf of Aqabah and Dead Sea Rift. Active tectonics in this region is associated with the opening of the northern Red Sea and Gulf of Aqabah as well as a major continental strike-slip plate boundary.

The Dead Sea transform system connects active spreading centers of the Red Sea to the area where the Arabian Plate is converging with Eurasia in southern Turkey. The Gulf of Aqabah in the southern portion of the rift system has experienced left-lateral strike-slip faulting with a 110 km offset since early Tertiary to the present. The seismicity of the Dead Sea transform is characterized by both swarm and mainshock-aftershock types of earthquake activities. The instrumental and historical seismic records indicate a seismic slip rate of 0.15-0.35 cm/year during the last 1000-1500 years, while estimates of the average Pliocene-Pleistocene rate are 0.7-1.0 cm/year.

Previous seismicity studies in the Gulf indicate a relatively lower seismic activity (Ben-Menahem 1979). However, lately there were recent seismic activities that have occurred. These were the 1983 sequence that lasted about 2 months and associated with a maximum magnitude (Mmax) of 5.2. In April 1990 and in May 1991 which have peak Mmax of 4.3 respectively were another 2 set of earthquake sequences that have occurred. These two swarms indicate a spatial overlap with the southern part of the 1983 events, suggesting the 1983, 1990, and 1991swarms were a part of one tectonic segment and activity in the Elat deep. The sequences were followed later by the 1993 event which was located in the Aragonese Deep with Mmax of 5.8. The latest earthquake of concern that is located also in the Aragones Deep is the 1995 event with Mmax of 7.1, which is the strongest among the events that has occurred in the gulf.

Seismicity activities in the Gulf of Aqabah have been dominated by earthquake sequences lasting for about 1-3 months, with a clear pattern of spatial distribution that cover a specific tectonic segment. Each segment is observed to goes through a seismic swarm cycle. Interaction between segments influences the time period of their cycle.

Historically, the most significant earthquakes to hit the Dead Sea region were the events of 1759 (Damascus), 1822 (Aleppo), and of 1837 ;1068 (Gulf of Aqabah area) caused deaths of more than 30,000 people. *Ben Menahem* (1979) indicated that about 26 major earthquakes ($6.1<ML<7.3$) occurred in southern Dead Sea region between 2100 B.C. and 1900 A.D. In 1980's and 1990's, the occurrence of earthquake swarms in 1983, 1985, 1991, 1993 and 1995 in the Gulf of Aqabah clearly indicates that this segment is one of the most seismically active zones in the Dead Sea transform system. Earthquake locations provide evidence for continuation of faulting regime from the Gulf northeastward inland beneath thick sediments, suggesting that the northern portion of the Gulf is subjected to more severe seismic hazard compared to the southern portion (*Al-Amri et al.*,1991 ; Thenhaus et al., 1986).

Seismic activity in the Arabian shield appears to be low. There were only few moderate seismic events composed of 25 ($4.0<Ms<5.9$) and 1 ($Ms>6.0$) to have occurred since 1900. However, historical accounts (Ambraseys 1988) indicated that strong ground shaking has been felt in the northwestern portion of the shield during the 1068 event (Ms7.0) and 1588 event (Ms6.7). The Ms(7.0) was accompanied by ground cracking and fissuring that caused widespread destruction. The central portion was also shaken in the year 1269 which was felt at Taif. This earthquake was associated to the activity of the right lateral NE trending Ad Damm fault which passes close to Taif. In 1256, the City of Madinah also experienced ground shaking. However, the shaking phenomenon was more related to volcanic activity (Fig.5).

In contrast to the scarcity of information regarding earthquakes in the northern and central portion of the shield that has affected the population, a continuous document of felt, strongly felt, and destructive earthquake occurrences in Yemen since the year 742 was compiled by Ambraseys (1988). The location of these earthquake events are primarily distributed in the Yemen Trap Series. The 13 of December 1982 Dhammar earthquake (Ms6.1) killed 2,000 people, destroyed 300 villages, and rendered 700,000 homeless.

To the south, the majority of earthquakes and tectonic activity in the Red Sea region are concentrated along a belt that extends from the central Red Sea region south to Afar and then east through the Gulf of Aden. There is little seismic activity in the northern part of the Red Sea, and only three earthquakes have been recorded north of latitude 25^{o} N. Instrumental seismicity of the northern Red Sea shows that 68 earthquakes ($3.8<mb<6.0$) are reported to have occurred in the period from 1964 to 1993 (Fig. 5).

Historically, about 10 earthquakes have occurred during the period 1913-1994 with surface-wave *(Ms)* magnitudes between 5.2 and 6.1. Some of these events were associated with earthquake swarms, long sequences of shocks and aftershocks (the earthquakes of 1941, 1955, 1967 and 1993). The occurrence of the January 11,1941 earthquake in the northwest of Yemen ($Ms = 5.9$) with an aftershock on February 4, 1941 (Ms = 5.2), the earthquake of October 17, 1955 (Ms = 4.8), and the 1982 Yemen earthquake of magnitude 6.0 highlight the hazards that may result from nearby seismic sources and demonstrate the vulnerability of northern Yemen to moderate-magnitude and larger earthquakes. Instrumental seismicity of the southern Red Sea shows that 170 earthquakes ($3.0<mb< 6.6$) are reported to have occurred in the period 1965-1994. The historical and instrumental records of strong shaking in the southern Arabian Shield and Yemen (1832; 1845; 1941; 1982 and 1991) indicate that the return period of severe earthquakes which affect the area is about 60 years (*Al-Amri*,1995 b).

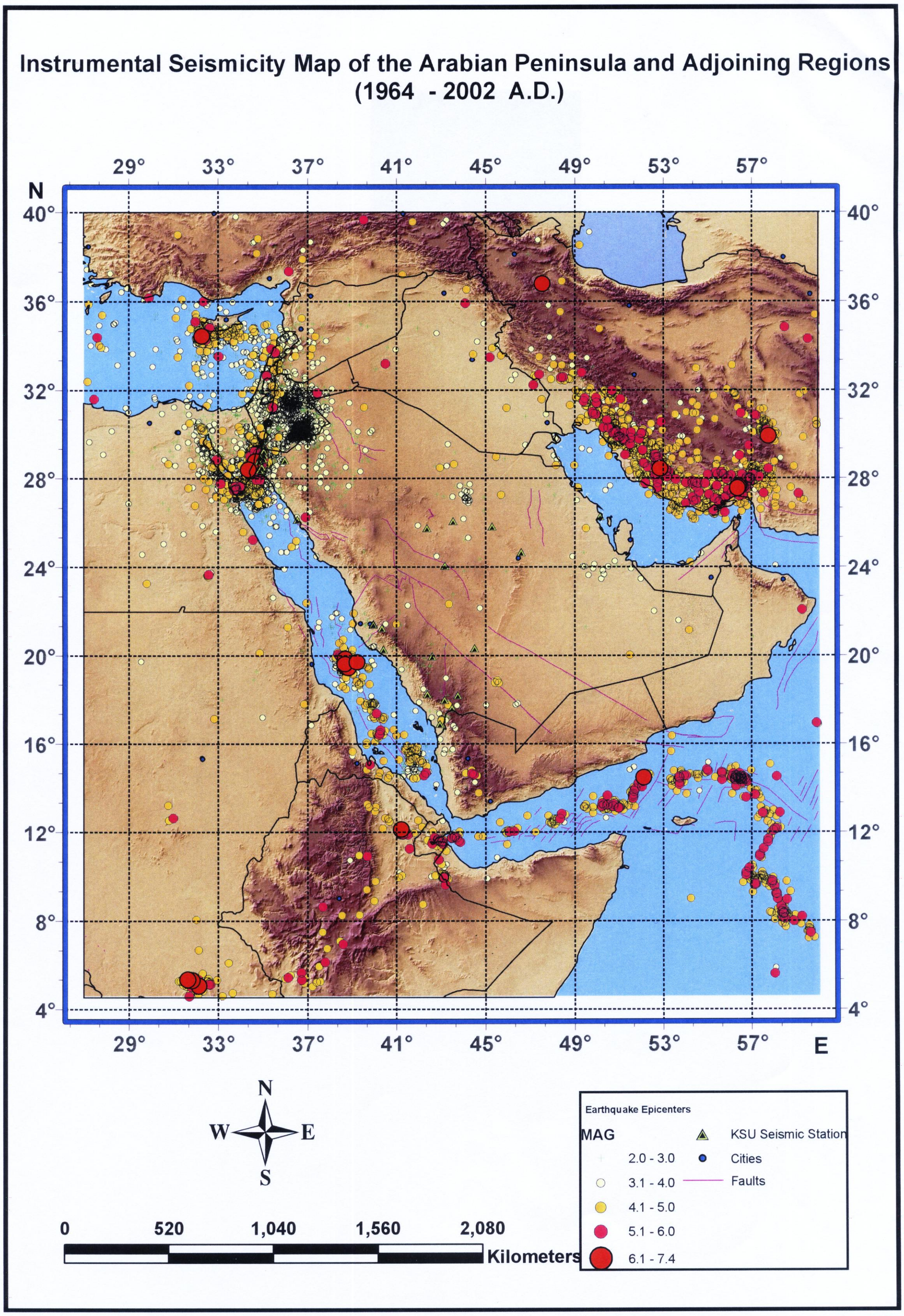


Fig. 5. Seismicity map of the Arabian Peninsula

جدول الزلازل التاريخية والحديثة في شبه الجزيرة العربية التي تم تدوينها وتسجيلها

خلال الفترة من ١١٢ – ٢٠٠٢م

المنطقة	القدر الزلزالي من ٢ –٢,٩٩	القدر الزلزالي من ٣ –٣,٩٩	القدر الزلزالي من ٤ –٤,٩٩	القدر الزلزالي من ٥–٥,٩٩	القدر الزلزالي أكبر من ٦
خليج العقبة ٣٤–٣٦ شرقاً ٢٨–٣٠ شمالاً	٢٦٩٤	٢٤١٣	٥٥٧	٤١	٥
شمال البحر الأحمر ٣٤–٣٩ شرقاً ٢٤–٢٨ شمالاً	١٩١	٢١٦	٥٢	١٠	٢
وسط البحر الأحمر ٣٥–٤١ شرقاً ١٩–٢٤ شمالاً	٨٦	٧٩	٦٧	٢٦	٦
جنوب البحر الأحمر ٣٧–٤٤ شرقاً ١٢–١٩ شمالاً	١٨٢	٢٠١	١١٠	١٠١	١٥
وسط المملكة ٤٤–٤٨ شرقاً ٢٣–٣٠ شمالاً	٩	١٩	٢	٢	صفر
جنوب الخليج العربي ٤٨–٥٧ شرقاً ٢٣–٣١ شمالاً	١٢	٦٠	٧٣٦	٢٤٣	١٤

The Arabian Plate boundary extends east-northeast from the Afar region through the Gulf of Aden and into the Arabian Sea and Zagros fold belt. The boundary is clearly delineated by teleseismic epicenters, although there are fewer epicenters bounding the eastern third of the Arabian Plate south of Oman. Most seismicity occurs in the crustal part of the Arabian Plate beneath the Zagros folded belt (*Jackson and Fitch*,1981). The Zagros is a prolific source of large magnitude earthquakes with numerous magnitude 7+ events occurring in the last few decades. The overall lack of seismicity in the interior of the Arabian Peninsula suggests that little internal deformation of the Arabian Plate is presently occurring.

The overall lack of seismicity in the interior of the Arabian Peninsula suggests that little internal deformation of the Arabian plate is presently occurring. There is widespread Quaternary volcanism along the Red Sea coast, with at least one documented historical eruption in 1256 A.D. Some seismicity was associated with that eruption. Seismicity may also be related to transform faults in the Red Sea continuing onto land as well as other causes. To date, few on-land epicenters are accurately located and there are few focal mechanisms available.

2.2 Seismic Structures

Seismic structure studies of the Arabian Peninsula have been varied, with dense coverage along the 1978 refraction survey and little or no coverage of the aseismic regions, such as the Empty Quarter. In 1978, the Directorate General of Mineral Resources of Saudi Arabia and the U.S. Geologic Survey conducted a seismic refraction survey aimed a determining the structure of the crust and upper mantle. This survey was conducted primarily in the Arabian Shield along a line from the Red Sea to Riyadh. Reports of crust structure found a relatively fast velocity crust with thickness of 38-43 km (*Mooney et al*,1985; *Mechie et al*,1986; *Gettings et al*,1986, *Badri*,1991). The crust in the western shield is slightly thinner than that in the eastern shield.

Mooney et al.(1985) Suggest that the geology and velocity structure of the Shield can be explained by a model in which the Shield developed in the Precambrian by suturing of island arcs. They interpret the boundary between the eastern shield and the Arabian Platform as a suture zone between crustal blocks of differing composition.

Surface waves observed at the long-period analog stations RYD (Riyadh), SHI (Shiraz, Iran), TAB (Tabriz, Iran), HLW (Helwan, Egypt), AAE (Addis-Ababa, Ethiopia) and JER (Jerusalem) were used to estimate crustal and upper mantle structure (*Seber and Mitchell*, 1992; *Mokhtar and Al-Saeed*,1994). These studies reported faster crustal velocities for the Arabian Shield and slower velocities for the Arabian Platform.

The Saudi Arabian Broadband Deployment (*Vernon and Berger et al*., 1997; *Al-Amri,* 1998) provided the first data set of broadband recordings of this region. This deployment consisted of 9 broadband three-component seismic stations along a similar transect an early seismic refraction study (*Mooney et al., 1985; Gettings et al.,1986; Mechie et al.,*1986). Data from the experiment resulted in several studies andd models (*Sandvol et al.,* 1998; *Mellors et al.,* 1999; *Rodgers et al.,* 1999; *Benoit et al.,* 2002). These studies provided new constraints on crustal and upper mantle structure. The crustal model of the western Arabian Platform shows a little higher P-velocity for the upper crust in the Shield than in the Platform and the crustal Platform seems to have a greater thickness than in the Shield by about 3 km. The Moho discontinuity beneath the western Arabian Platform indicates a velocity of 8.2 km/sec of the upper mantle and 42 km depth (*Al-Amri,*1998;1999).

Generally the crustal thickness in the Arabian Shield area varies from 35 to 40 km in the west adjacent to the Red Sea to 45 km in central Arabia (*Sandvol et al.,* 1998; *Rodgers et al.,* 1999). Not surprising the crust thins nears the Red Sea (*Mooney et al.,*1985; *Gettings et al.,*1986; *Mechie et al.,*1986). High-frequency regional S-wave phases are quite different for paths sampling the Arabian Shield than those sampling the Arabian Platform (*Mellors et al.,* 1999; *Sandvol et al.,*1998). In particular the mantle Sn phase is nearly absent for paths crossing parts of the Arabian Shield, while the crustal Lg phase is extremely large amplitude. This may result from an elastic propagation effect or extremely high mantle attenuation and low crustal attenuation occurring simultaneously, or a combination of both.

Previous reports of large scale seismic structure (e.g. *Ritsema et al.,*1999 and *Debayle et al.,*2001) suggest that a low velocity anomaly in the upper mantle extends laterally beneath the Arabian Shield from the Red Sea in the west to the shield – platform boundary in the east. Additionally, *Debayle et al.* (2001) observe a narrow region of low velocity beneath the Red Sea and western edge of the Arabian Shield, extending to 650 km depth. A recent tomographic velocity model and receiver function analysis by *Benoit et al.* (2002) suggests the upper mantle low velocity anomaly is smaller in extent, laterally and vertically, than imaged in previous studies.

In order to select a single velocity model to be representative of the paths sampled in the Arabian Peninsula, Al-Amri and Alkhalifah (2004) made use of the results of a seismic refraction and a recent composite model of crustal thickness (*Seber et al*., 1997). Their grid search results with the thicker crusts (28-30 km) are consistent with these earlier studies. A grid search was also used to quickly find a range of models that satisfactorily fit the dispersion data, then that range of models was explored to fit the three-component broadband (10-100 seconds) waveforms. The resulting models revealed significant differences between the lithospheric structure of the three regions. The resulting models are plotted in tables 1, 2 and 3 (Al-Amri and Alkhalifah, 2004).

Table 1. Preferred Velocity Model for the Gulf of Aqabah/Dead Sea Region

DEPTH (KM)	THICKNESS(KM)	V_P (KM/S)	V_S (KM/S)
0	2	4.50	2.60
2	5	5.50	3.18
7	10	6.10	3.52
17	11	6.20	3.60
28	∞	7.80	4.37

V_P and V_S are the P- and S-wave velocities, respectively.

Table 2. Preferred Velocity Model for the Arabian Shield Region

DEPTH (KM)	THICKNESS(KM)	V_P (KM/S)	V_S (KM/S)
0	1	4.0	2.31
1	15	6.20	3.58
16	20	6.80	3.93
36	∞	7.90	4.30

V_P and V_S are the P- and S-wave velocities, respectively.

Table 3. Preferred Velocity Model for the Arabian Platform Region

DEPTH (KM)	THICKNESS(KM)	V_P (KM/S)	V_S (KM/S)
0	4	4.00	2.31
4	16	6.20	3.64
20	20	6.4	3.70
40	∞	8.10	4.55

V_P and V_S are the P- and S-wave velocities, respectively.

3. SEISMIC DATA TREATMENT

3.1 Data Sources

In the statistical characterization scheme for the seismogenic source zones in the Arabian Peninsula, different set of seismic data for 2 observation period were compiled and analyzed. The set of observation period were as follows:

(a) Historical period : 112 – 1964 AD

(b) Instrumental Period : 1965- 2003 AD

The source catalogues from which the utilized seismic data are taken were the United States Geological Survey (USGS) PDE/EDR: 1963-2003; the International Seismological Center (ISC): 1963-2003: Ambraseys (1988) from 112-1963 AD; the European Mediterranean Seismological Center (EMSC): 1990-2003; the Seismic Studies Center (SSC) of King Saud University from 1986-2003, and the Kuwait National Seismological Network (KNSN) from 1997-2003. The seismic data obtained from these different seismic bulletins were merged and compiled to provide the main database for delineation and identification of the different seismogenic source zones in the Arabian peninsula and for statistical analysis. The compiled seismic data were likewise utilized in the seismotectonic correlation of the activity in each source area. Different types of magnitude such as surface-wave (Ms), body-wave (Mb), local (Ml), duration (Md), macro (Io), and others were converted to two types which are the surface-wave and body-wave to homogenize the main database. The purpose of homogenizing the database is due to the appropriateness of using the Ms in the concept of seismic moment, while the Mb for the seismicity parameters. Appropriate conversion relations were applied in these purposes (Al-Amri et al., 1998).

3.2 Incompleteness Analysis

Incompleteness of database cannot be avoided as there several factors and constraints that are involved. Absence and insufficiency, and or low detection capability of sensing seismic instruments in microseismic observation of earthquakes. Scarcity and inadequacy of physical factors involved in the macroseismic observation of seismic events. Completeness analysis of the data base was not conducted due to encountered constraints that can hamper the analysis. These are the subdivision of the database in two period of observation, the observed insufficiency of seismic data in most of the seismogenic source zones, and in view of zero number of seismic events in some magnitude intervals. Reliability may range from 0.2-0.5 degree in distance, 0.5 in magnitude, and one degree scale in intensity are possible to attain in the procedure of completion (Table 4).

Table 4. Incompleteness Correction Factors

Magnitude	Hist.	Instr.
4.4	3	1.5
4.8	3	1.5
5.2	2	1
5.6	2	1
6	1.5	1
6.4	1.5	1
6.8	1.5	1
7.2	1	1

3.3 Elimination of Cluster Events

A counter-checking of all the relevant data entries in the catalogues was undertaken to ensure non-duplication of the same earthquake events. For each seismic zone, the minimum magnitude value is 4.0 for all the set of observation period. Under the historical data, the magnitude type is the surface wave (Ms), while for the instrumental data, the magnitude type is the body-wave (mb) that were used respectively in the seismic analysis. These are due to the reasons that the bulk of seismic data is Ms in the historical and mb in the instrumental data. Different types of magnitude occur in the seismological catalogues which include intensity data from historical events. To have complete, homogenous, and consistent database, there was a need for converting one type of magnitude to the other types or other seismic parameters. The utilized conversion equations were:

$$Ms = 0.53\ Io + 2 \qquad (1)$$

$$mb = 0.46\ Io + 2.53 \qquad (2)$$

$$mb = 0.87\ Ms + 0.79 \qquad (3)$$

where Io is the epicentral intensity in the MSK intensity scale and the other parameters were as defined formerly. The above empirical relations were taken from Al-Amri et al. (1998). It is assumed that the local magnitude (Ml) is equivalent to Ms. The duration/coda magnitude is the same as mb. These two types of magnitudes (Ms, mb) are presumed to be generally the respective standard values as bases in the determination of the empirical relations for Ml and Md used by some seismological agencies in the EMR.

3.4 Missing Magnitudes

Missing magnitudes from the historical up to the instrumental period were not considered. The magnitude interval characterizing the missing magnitude for the historical data is large (1.5-2 units) as deduced from Ambraseys (1988), while for the instrumental events are less than 3. The effects of the distribution and inclusion of these missing events shall be similar to the presence of clustering in the database due to uncertainty in the appropriate magnitude values and an increase in the number of unwanted seismic events.

3.5 Seismicity Parameters

The compiled seismic data in each seismogenic source zone in each observation period were analyzed to obtain the respective values of the seismicity parameters a and b. The cumulative frequency-magnitude relation :

Log N (M) = a – bM **(4)**

was applied in the determination of the seismicity parameters in each source zone. M is the magnitude, N is the total number of events equal and larger than M, a is the seismicity index parameter, and b is the parameter related to the applied stress. This relation (4) was utilized due to the following reasons:

- there were zero number of events in some magnitude intervals
- the cumulative number of events is directly given by the observed data.

The analysis performed and conducted in each seismic source zone using (4) is carried out into magnitude intervals of increasing increment of 0.1 magnitude unit starting from 0.1 up to 0.5. From these analyses, the best fit was selected as the most representative cumulative frequency-magnitude relation for each observation period in each seismogenic source zone.

There is no fast and hard rule in eliminating foreshocks, aftershocks, and swarm type of earthquake events from the normal background seismicity of an area. Aside from review of the seismic data, the second approach is to remove the excess number of events that deviate from the general linearity of (4) to diminish the influence of the other type earthquake regime. The omission of aftershocks resulted in the decrease of b by amounts smaller than 0.1. This value falls within the range of standard deviations or differences caused by working procedures (Karnirk 1969). A more substantial influence cannot be excluded when strong shallow earthquakes are followed by numerous aftershocks and the period of investigation coincides with such sequence (Table 5).

In the majority of cases for the seismogenic source zones with sufficient data, the distribution of representative values of Log N(M) plotted for equal magnitude classes fits a straight line fairly well within a certain range of magnitude. A steeper change of slope is observed to occur within the higher magnitude classes and lower slopes for the lower magnitude classes. The earthquakes whose magnitude values fall in the non-linear part are called characteristic earthquakes of the region. Such a pattern is often observed in regions of moderate seismicity as observed in some of the selected seismogenic source zones in the region, where return periods of the large earthquakes exceed the period of observation.

Calculations for the seismicity parameters were undertaken in each observation period in each seismic source when the number of data are equal to 9 and above. It is shown by Aki (1965), that for smaller number of events, the upper and lower confidence limit for the b value is large even with small probability. Although the minimum number of events that can be used in calculation of the seismicity parameters is 4, the validity of the results are uncertain.

3.6 Maximum Magnitude

It should be noted that the hypothesis of linearity in (4) is correct only if the considered magnitude interval is not too large. It is also clear that this may end to unrealistic results the extrapolation of (4) in magnitude ranges outside the observed data. This is mainly due to the absence of a limiting value for M, while it is evident that such limits must exist due to physical consideration. Hence, (4) is supposed to be valid only for magnitude less than or equal to a limiting value Mt, giving Log N(M) =0 when M> Mt (truncated distribution). An upper magnitude limit has to be defined, chosen as Mmax = (a/b) where a and b are the constants in (4). This Mmax refers only to the limited data upon which (4) is regressed. Mmax is not the absolute maximum magnitude, but only relative to the utilized data.

In this study, the cut off magnitude is taken to be the observed maximum magnitude developed by the source plus 0.25 (Al-Haddad et al., 1994).

Table 5. Seismicity parameters for seismic zones in the Arabian Peninsula

Zone No.	Name	Seismicity Parameters		
		A	B	Mag_{max}
1	Gulf of Suez	4.66	0.67	7.0
2	Gulf of Aqaba-Dead Sea	4.93	0.67	7.4
3	Tabuk			
4	Northwestern Volcanic Zone			
5	Midyan-Hijaz			
6	Duba-Wajh Area	4.77	0.82	5.8
7	Yanbu			
8	Southern Red Sea-Jeddah	4.67	0.7	6.7
9	Makkah Region			
10	Southern Red Sea-Al Darb	5.14	0.75	6.9
11	Abha-Jizan	3.08	0.55	5.6
12	Southwestern Arabian Shield	3.62	0.5	7.2
13	Gulf of Aden	4.71	0.67	7.0
14	Sirhan-Turayf-Widyan Basins	3.21	0.59	5.4
15	Najd Fault Zone	2.34	0.59	4.6
16	Central Arabian Graben Zone	3.64	0.66	5.5
17	Arabian Gulf	4.02	0.65	6.2
18	Zagros Fold Belt	6.83	0.94	7.2
19	Sanandaj-Sirjan Ranges	5.84	0.84	6.9
20	Southern Yemen			
21	Rub Al Khali-Ghudun Basins	2.42	0.51	4.8
22	Bandar Abbas-Dibba Region	7.15	1.0	7.2
23	Makran-Hawasina Thrust Zone	3.35	0.59	5.7
24	East Sheba Ridge	6.06	0.85	7.1
25	Masirah Fault Zone	4.35	0.71	6.1

4. MODELING OF SEISMIC ZONES

The empirical and theoretical correlational methods and distribution function that were applied in the western part of Saudi Arabia seismogenic source zones are similarly utilized for the eastern section. This approach is conducted to maintain uniformity and homogeneity of results.

The seismotectonic modeling of the seismogenic source zones of the Arabian Peninsula were based on the following empirical and theoretical correlations. The empirical correlation was taken from observation of earthquakes occurring in tectonic structures (Gubin 1967; Allen 1975). These are as follows:

4.1 Correlation between seismic and tectonic data

(a) Earthquakes do not occur everywhere, but only in definite tectonically active areas and in strong accordance with movement and deformation of geological structures. Globally, there were close relation between active faults and strong earthquakes, but the relations are not so strong in other areas characterized by less long term seismicity. The Earth is partitioned among large seismogenic and aseismogenic belts, which are apportioned further into smaller source zones. The seismogenic source zones have active faults at different depths, concealed in the depth or exposed on the surface. A seismogenic zone is therefore a main unit that determines the seismic conditions of a territory. The source zones are of different size and kind. In every zone occur earthquakes up to a definite value of the seismic parameters. These are due to varying size, degree of competency, and rate of movement, so that earthquakes correspondingly vary with the parameters.

(b) Major earthquakes occur along tectonically active source zones having large faults. The zones which divide geological units having different history of development and large difference in rates of movement are the most seismically active. The larger is the disturbed structure and the greater is its competency, the larger is the fault plane affected by the abrupt movements and the sronger will be the earthquake. Correspondingly, every group of homogeneously disturbed structure with definite competency and size has a definite ceiling of magnitude value. The more is the rate of structure movements along a fault and the less is the competency of these structures, the more rapidly the stress needed for an abrupt displacement of a structure along a fault is accumulated and the more often arise earthquakes of the maximum magnitude value for this structure. Every tectonically active source zone has its own rate of movement along it and corresponding frequency of earthquake occurrences.

(c) Geological structures move abruptly on faults along tectonically homogeneous active zone not simultaneously but alternatively in different places of the zones. Alternatively, in different places in this zone arise earthquake of maximum magnitude for this zone. When a source of an earthquake of certain maximum strength was recorded in this homogeneous active zone, then earthquake of the same strength can occur anywhere along this zone. In other word, the probability of such an earthquake can be extrapolated and interpolated along homogeneous tectonically active zones.

4.2 Correlation between Earthquake Frequency and Mechanics of Faulting

The geological interpretation of the mechanism of an earthquake could possibly have started by Lawson in 1908, which was translated by Reid (1910) into quantitative terms. The concept established the theoretical and physical correlation between occurrence of earthquakes and deformation of tectonic structures.

The most important parameter in mechanics of faulting as related to occurrence of a seismic event is the seismic moment (Mo).

Mo = uAD = uLWD **(1)**

where u is the rigidity, A is the fault plane area, L and W are the length and width of the fault respectively, and D is the displacement. The amplitude of the long period waves is proportional to the seismic moment. Since the surface magnitude (Ms) is calculated by measuring the amplitude of the long period wave, there exist a close relationship between Mo and Ms, and so with Mo, length and displacement arising from static similarity. For this study, the relationships are obtained empirically, which is a world-wide data collection of corresponding magnitude, moment, length, width and displacement. The empirical relationships that were obtained are as follows:

Log Mo = [(1.62+-0.112)Ms + 15.1] +-0.3 **(2)**

Log Mo = [(2.54+-0.087)Log L + 22.56] +-0.31 **(3)**

Log Mo = [(2.61+-0.28)Log D +26.32] +-0.44 **(4)**

From (2-4), the following equations can be obtained when the standard deviation and standard error of estimate are not incorporated

Log L = 0.64Ms – 2.94 **(5)**

Log D = 0.62Ms – 4.3 **(6)**

Equation (2) is within the range of values (1.5-1.7) as obtained by Kanamori (1977), Hanks & Kanamori (1977). Equations (5) and (6) are close to Matsuda (1975) results which are 0.6, 2.9: and 0.6, 4 for the coefficients and constants respectively. The rupture is assumed to take place in the entire length of the homogeneous part of the fault or portion for segmented fault. The constraining equations for the fault length, dislocation, and magnitude are from (2-4)

1.52LogD + 7.25 < Ms < 1.69LogD + 6.65 **(7)**

1.55LogL + 4.36 < Ms < 1.6LogL + 4.94 **(8)**

The magnitude frequency relation of earthquakes satisfies the empirical relation (Gutenberg & Richter 1954)

Log N = a – bMs **(9)**

where N is the number of magnitude Ms or greater, a and b the seismicity parameters. Equation (9) holds down to the level of micro-events (Mogi,1962) which indicates a fundamental physical understanding of the fracture process can be known if the relation can be explained completely. The Mo and Ms are both measures of the strength of an earthquake, so that (9) can be expressed in terms of Mo by means of (2). The theoretical consideration that the magnitude scale saturates at higher values of magnitude, but not with Mo is appropriate to substitute the seismic moment frequency relation for characterizing earthquake occurrences. From (2) and (9), a power law size distribution of earthquakes can be obtained (Wyss 1973)

$$\mathbf{N(Mo) = Amo^{(-B)}} \qquad \mathbf{(10)}$$

$$\mathbf{A = exp[(a + bc/d)ln10]}$$

$$\mathbf{B = b/d}$$

where a and b, c and d are the constant and coefficient in (9) and (2) respectively. From Wyss (1973), the total moment of a given earthquake population is the integral

$$\mathbf{Mo(tot) = (AB/(1\text{-}B)[Mo^{(1-B)}]} \qquad \mathbf{(11)}$$

where the upper and lower limits of integration are Mo(max) and Mo(min) as the maximum and minimum seismic moment in a given earthquake population respectively. In (10) it is assumed that the Mo(max) is attained when N(Mo)=1, so that $A=Mo^B$. Likewise, in (9) the Mmax is also attained when N(M) =1. If Mo(min) is insignificant compared to Mo(max), (11) becomes approximately equal to

$$\mathbf{Mo(tot)= B/(1\text{-}B)Mo(max)} \qquad \mathbf{(12)}$$

From Wesnousky and Scholz (1983), the repeat time (Tmax) of (11) is

$$\mathbf{T(max) = Mo(tot)/Mo(g)} \qquad \mathbf{(13)}$$

where Mo(g) is the geologically assessed rate of moment release on a fault.

In (6), the recurrence time (Tmax) of an event with dislocation D is

T(max) = D/S **(14)**

where S is the linear average seismic slip rate.

The geologically assessed rate of moment release is not available in eastern Saudi Arabia. To be able to utilize the concepts enunciated in (9-14) for the correlation of regional seismicity to tectonics, there was a need to treat the 3 set of seismic data (historical, instrumental, recent) into one group in each seismogenic source zone in terms of Ms, to obtain the required parameters. The conversion equation was (Al-Amri et al 1998).

Ms = 1.14 Mb -0.9 **(15)**

where Mb is the body-wave magnitude.

Wesnousky and Scholz (1983) had indicated that the average geological moment release rate is almost the same as the average seismic moment release rate in 200-300 year of seismic data, and similar to the geological rate for 400 year of data. It is assumed then that the findings for seismic moment release rate have also the same similarities to the linear average seismic slip and or spreading rate. The period of observation in each source zone is counted from the earliest recorded year of the data up to 2003.

The geologically assessed rate of moment release is assumed to be equal to the ratio of the cumulative seismic moment release and period of observation. This assumption was also applied to obtain the linear average seismic slip or spreading rate. The average slip rate in each zone with sufficient seismic data could be compared to other findings obtained from different sources for validation. If the seismic slip rates are compatible to other results, presumably the seismic moment release rates would also qualify. When sufficient data are not available, the other alternatives could be to assume the applicability of the other parameters obtained in neighboring seismic source zones and or using (12).

The expected maximum magnitude in each seismogenic source zone is either taken from (9) [Mmax(S)], or the observed maximum magnitude Mmax(O) from the set of seismic data in each source zone, and or the estimated magnitude [Mmax(L)] from fault length of the existing fractures in each respective seismogenic source zone. The expected Mmax(S) and or Mmax(O) are then correlated to fault length in (5) or dislocation in (6), and the magnitude from crustal depth (H) which is given as

$$\mathbf{Mmax(H) = 4Log\ H + 1.8} \qquad \textbf{(16)}$$

The corresponding feasibilities in (5), (6), (9) and (16) could indicate possible association and characterization of the most likely source of the given earthquake population in each seismogenic source zone.

Earthquakes are not equally distributed in space-time, although probably the seismic events follow physical causalities which are not fully known. Therefore, at least the strongest earthquakes can be assumed to be independent random events. Considering the probability of occurrence of these seismic events in a time interval (t), and assuming the Poisson process as the appropriate probability function applicable in the source zones, then the probability of occurrence (Pr) of an event with return time (Tmax) is given as

$$\mathbf{Pr = 1\text{-}exp(\text{-}t/Tmax)} \qquad \textbf{(17)}$$

Because there were different constraints encountered in the correlation processes such as scarcity of seismic data and inadequate information concerning fault parameters. It became necessary to refer to (17) as an additional data and basis in the decision processes. The time interval is assumed to be 100 years.

Slemmons (1981) had described a characterization scheme for fault rate activity. The classification is as follows: (a) fault not active; (b) hardly active; (c) well developed geomorphologically (medium to high); (d) high; (e) very high; and (f) extremely high. The basis of the classification was the inverse of the linear slip rate as the constant slope of a linear relation between recurrence time and dislocation (eq.14) which is expressed in terms of magnitude. For slip rate of 10 cm/yr, the fault rate of activity is extremely high for magnitude range 4.8-9, for slip rate of 1 cm/yr, the fault rate activity varies from extremely high to very high for the magnitude range 4.7-9, for slip rate 0.1 cm/yr, the fault rate activity also varies from extremely high-to very high- to high for the magnitude range 4.7-9, for slip rate 0.01 cm/yr, the fault rate activity varies from very high- to high- to medium high for the magnitude range 4.7-9, and for slip rate 0.001 cm /yr, the fault rate activity varies from high-to medium high-to hardly active - to fault not active for the magnitude range 4.7-9..

5. DELINEATION OF SEISMIC ZONES

In the identification and delineation of seismic source zones, some criteria were followed and utilized as guidelines. The criteria are:

1. Seismological parameters- map of the planar distribution of earthquake epicenters (fig. 5) that could indicates both seismogenic provinces and seismoactive faults, and occurrence. Of large earthquakes, the level of which depends upon on the seismic activity in the region. When required and necessary, the magnitudes can be converted to energy values to show the energy flux distribution for better correlation. This procedure can also be applied to the parameter intensity by means of an appropriate conversion relation or conversely a distribution map of the observed maximum intensities in the region. Historical earthquakes are described mostly in terms of intensity and it would seem appropriate to use this parameter as an additional guide. In using the spatial distribution of epicenters as a guideline, boundaries of zones are drawn in such a way that a cluster or more clusters of earthquakes are included and crossed the region of minimum density of epicenters, but do not intersect the main tectonic provinces. The scatter of few seismic data over a wider area could lead to the formation of a seismic source zone with one event, provided the magnitude level is high compared to the level of background seismicity in the region. In principle, this system of clustering can also be applied to energy or intensity distribution to draw the boundary lines that encloses a particular seismic zone same as with the denseness of the epicenters of earthquake events.

2. Geological parameters- map of regional tectonics in the area (figs.1-3) which indicates the location of joints, faults, lineaments and rift systems that are associated with seismic activities. Fracture dislocations are the sources of seismic events. Seismogenic source zones are selected that are composed of a system of faults or lineaments or rift zones whose boundaries do not traverse generally other tectonic units.

3. Geophysical parameters- maps of heat flow and gravity anomaly distributions are useful in the interpretation on the nature of geologic structures. As can be seen on the two maps, there were gradual and distinct changes on the contours shapes and values. The contours shapes and spacing seemed to be consistent with the tectonic locations and orientations in the region. Seismic source zones boundaries are therefore drawn on these distinct or gradual changes.

The boundaries were the results in the inter-agreement of the 3 criteria, with the higher priority given to the spatial distribution of the earthquake epicenters due to statistical needs in seismicity investigation. Likewise, it is observed that some earthquakes cannot be connected to some line sources.

From these considerations, there were twenty five (25) identified and delineated seismogenic source zones for Saudi Arabia (fig. 6 and table 6). The seismogenic source zones are as follows:

Table 6. Seismic Source Zones of the Arabian Peninsula

Zone No.	Name	Cooridinates		Area (KM^2)
		Lat. N	Long. E	
1	Gulf of Suez	30.28	31.23	32058
		31.27	32.22	
		27.14	33.87	
		27.81	34.70	
2	Gulf of Aqabah-Dead Sea	32.31	35.22	43050
		32.28	36.48	
		28.33	33.30	
		27.81	34.73	
		28.81	34.02	
3	Tabuk	32.28	36.48	85032
		29.33	35.62	
		28.29	39.75	
		26.35	37.73	
4	Northwestern Volcanic Zone	26.35	37.73	98618
		22.36	40.81	
		23.33	41.72	
		28.29	39.75	
5	Midyan-Hijaz	28.33	35..30	36638
		29.33	35.62	
		21.72	40.24	
		22.36	40.81	
6	Duba-Wajh Area	28.33	35.30	67476
		26.62	33.25	
		23.82	35.74	
		25.62	37.58	

Zone No.	Name	Cooridinates		Area (KM^2)
		Lat. N	Long. E	
7	Yanbu	23.82	35.74	49614
		25.62	37.58	
		21.34	37.22	
		23.37	39.26	
8	Southern Red Sea-Jeddah	21.34	37.22	78009
		23.37	39.26	
		18.20	38.82	
		19.58	41.42	
9	Makkah Region	21.72	40.24	44958
		23.33	41.72	
		18.83	41.84	
		20.62	43.35	
10	Southern Red Sea-Al Darb	18.20	38.82	112358
		19.58	41.42	
		15.88	43.44	
		12.65	42.98	
11	Abha-Jizan	18.83	41.84	44958
		20.62	43.35	
		15.88	43.44	
		17.32	45.27	
12	Southwestern Arabian Shield	15.88	43.44	67323
		12.65	42.98	
		17.32	45.27	
		13.66	46.18	
13	Gulf of Aden	12.65	42.98	335851
		10.37	44.23	
		16.12	54	

Zone No.	Name	Cooridinates		Area (KM^2)
		Lat. N	Long. E	
		14.05	54.61	
14	Sirhan-Turayf-Widyan Basins	32.28	36.48	343516
		32.01	47.13	
		26.46	41.72	
		28.29	39.75	
15	Najd Fault Zone	28.29	39.5.75	379730
		20.62	48.36	
		17.32	45.27	
		20.2	43.1	
		23.33	41.75	
16	Central Arabian Graben Zone	26.46	41.72	533174
		30.86	46.02	
		23.52	51.46	
		20..62	48.36	
17	Arabian Gulf	30.86	46.02	257798
		32.01	47.13	
		25.96	54.17	
		23.52	51.46	
18	Zagros Fold Belt	32.01	47.13	160644
		32.01	50.11	
		27.31	55.6	
		25.96	54.17	
19	Sanandaj-Sirjan Ranges	32.01	50.11	148636
		32.0	53.84	
		28.8	57.3	
		27.31	55.6	

Zone No.	Name	Cooridinates		Area (KM^2)
		Lat. N	Long. E	
20	Southern Yemen	17.32	45.27	408636
		20.62	48.36	
		16.12	54.0	
		13.66	46.18	
21	Rub Al Khali-Ghudun Basins	20.62	48.36	403580
		24.16	52.22	
		19.69	57.32	
		16.12	54.0	
		18.02	55.62	
22	Bandar Abbas-Dibba Region	24.16	52.22	140096
		28.8	57.3	
		27.5	58.48	
		22.85	53.76	
23	Makran-Hawasina Thrust Zone	22.85	53.76	324060
		27.5	58.48	
		24.88	61.68	
		19.69	57.32	
24	East Sheba Ridge	16.12	54.0	209585
		18.02	55.62	
		14.09	59.46	
		11.99	57.44	
		14.05	54.61	
25	Masirah Fault Zone	18.02	55.62	238136
		24.88	61.68	
		14.09	59.46	
		19.69	57.34	

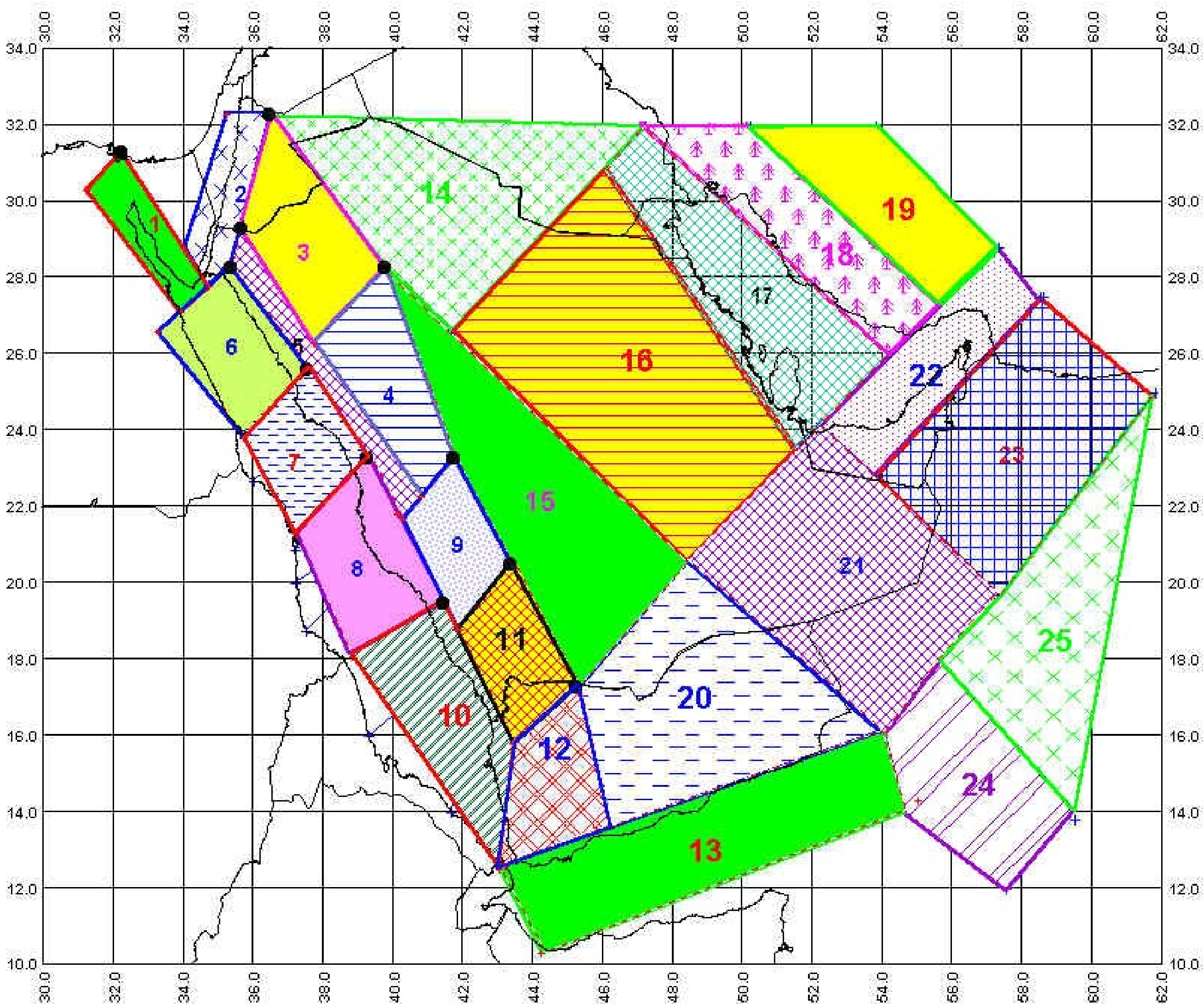


Figure 6. Seismic Source Zones of the Arabian Peninsula and Adjoining Regions

6. SEISMIC SOURCE ZONES

The characterization of the seismogenic source zones is composed of two parts. These are the brief discussions covering the possible association of each source zone to the tectonic and seismicity model of the areas contained in each source zone. The other part is a logic tree diagram for graphical description of the physical and seismicity parameters involved in seismotectonic correlation.

Two methods of approach were employed in the study. These are seismicity and fractures. Under the seismicity approach, the set of seismic data in each source zone was utilized to plot the magnitude-frequency relation, and for the estimation of the linear seismic slip and seismic moment release rates. From the frequency graphs, the respective seismicity parameters were determined for correlation to tectonic structures and probable earthquake source mechanisms. Under the second approach, the tectonic structures contained in each source zones were examined based on existing geological/tectonic maps for identification and association to the types of earthquake source mechanisms, and to the seismicity of the source area. Combination of the two approaches lead to the preliminary framework of a seismotectonic model for each seismogenic source zone.

From the findings, there were at most two types of sources for the tectonic model. These are the fault and area source. Under the fault source are the transcurrent and normal faults and their respective variations. Under the area source are the seismic events not directly associated to known presence of fractures or are off located, and or the sudden or randomly distributed dislocations of the ground within the source zones. Presumably, the causes of these seismic events under the area source are due to lateral and vertical structural discontinuities, or connected to some anomalous behavior of geophysical phenomena, and or undetected fractures.

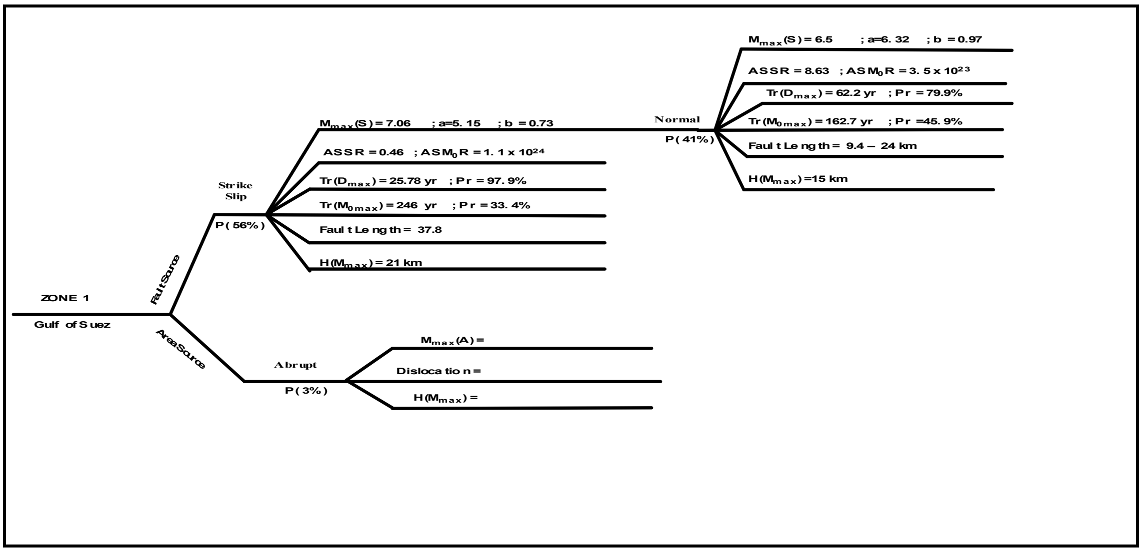
For earthquake source mechanisms, there are also at most two types. These are the extrusion and transcursion mechanisms. The zones of extrusion are the seats of volcanic activity and high heat flow. Seismological and other geophysical data suggest that ridges and their continental extension are characterized by rifting, spreading, and other aspects of extensional tectonics.

In summary, the schematic characterization of the twenty five seismic source zones in the Arabian Peninsula and adjoining regions are discussed :

Zone 1 (Gulf of Suez)

The general location of zone 1 is in the gulf of Suez. Its corner boundaries are indicated in the accompanying table for seismogenic source zones. Approximate area is 32058 sq. km. The partition of the seismic data into different period of observation gave different values of the seismicity parameters for this zone. As expected, b is not stable in time due to the changing level of seismic activity, changing stress rate or changing focal depth. It would seem that the b value is increasing in time. This is probably due to the accumulation of more data in the present stage of earthquake observation, absence of larger shocks, and shorter time interval.

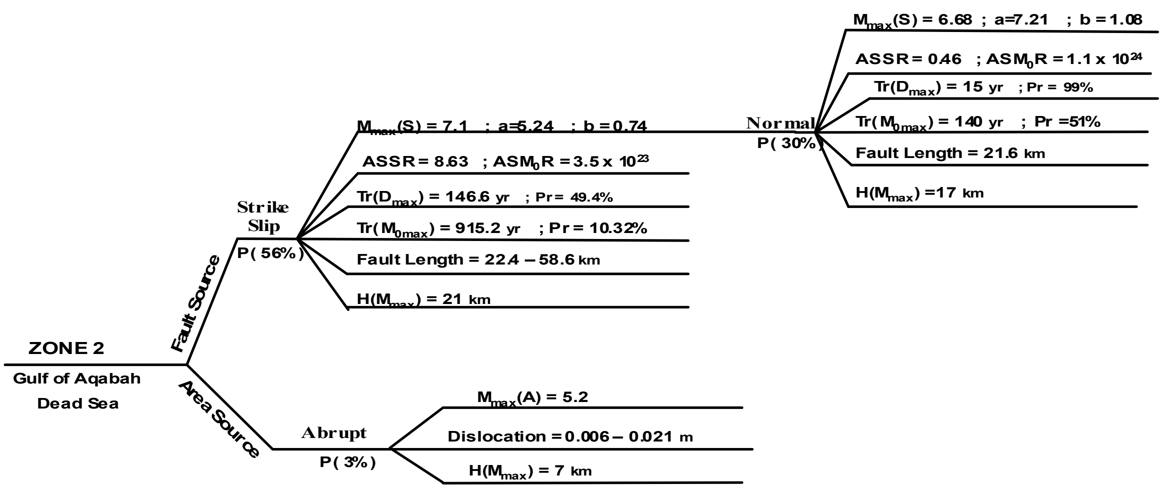
The compiled seismic data for this seismic zone fairly fits well the supposed linearity of (4). Under the historical period, the magnitude interval that gives the best fit is 0.4. This is expected since historical earthquakes are involved which from (1), the range of magnitude value for one Io is approximately +-0.5 magnitude unit. The sufficiency of earthquake events under the 3 period of observation indicates this zone to be active throughout the whole period of observation. Seismic activity could be associated to the presence of the shear zones and subsidence in this area.



M_{max}( ) : Expected maximum magnitude. Letter inside parenthesis means the source from which $M_{max}$is taken.
S=seismicity, O=observation, L=fault length, A=assigned
ASSR : Average seismicity slip rate in mm/yr
ASM_0R: Average seismic moment release rate (dyne-cm/yr)
P_r : Estimated probability of occurrence in 100 years
$H(M_{max})$: Depth of crustal structure corresponding to M_{max}
P : Assigned relative frequency of earthquake events for given tectonic source
TrD_{max} : recurrence time in years of expected maximum dislocation corresponding to M_{max}
$TrMo_{max}$: repeat time, in years, of an earthquake population with a M_{max}

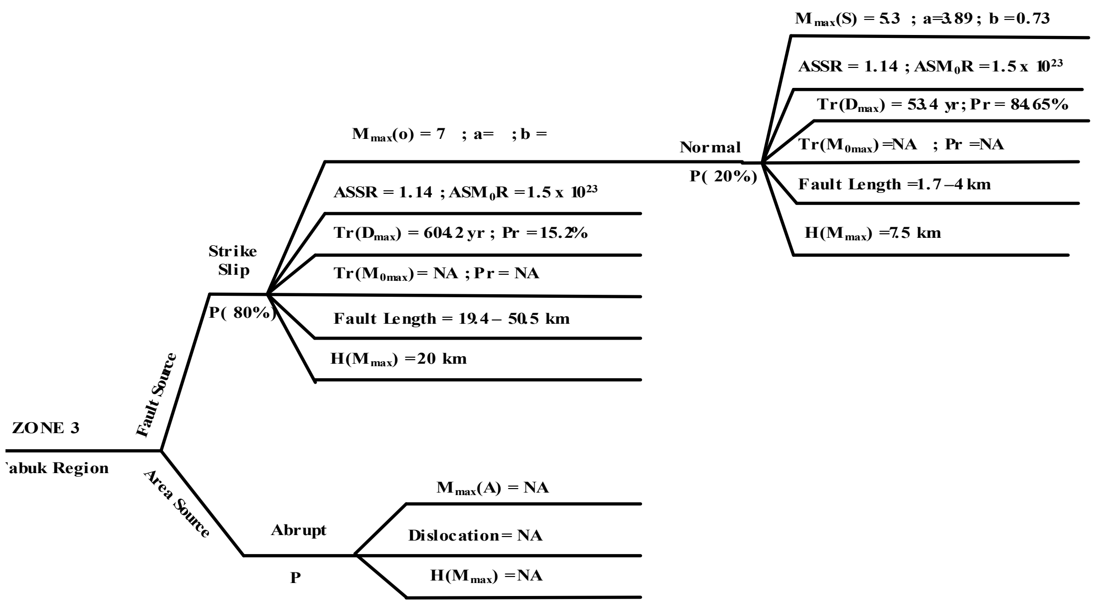
<u>Zone 2 (Gulf of Aqabah)</u>

The general location of zone 2 is in the gulf of Aqabah up to the Dead Sea. Corner boundaries for this zone are indicated in the accompanying table. Approximate area for this zone is 43050 sq. km. The b-values obtained for this zone tend to increase as time progresses. The historical and instrumental period of observation data generally fit well the assumed linearity of (4), but the recent seismicity era indicates moderate seismicity level as shown by the frequency-magnitude graph. The Mmax for this recent period is less than the observed maximum magnitude, indicating that period of observation is less than the return time of the observed maximum event. The sufficiency in the number of seismic events indicates that the seismic activity in this zone is continuous for the whole period of observation. Probable sources of the seismic activities in this zone are due to the movements of the left-lateral strike-slip NE trending Aqabah-Dead Sea transform fault.



<u>Zone 3 (Tabuk region)</u>

This zone covers generally the region of Tabuk. Its corner boundaries are indicated in the table. Approximate area of coverage is 85032 sq. km. The zone events have a total of 7 observed data. The historical period has 2 events, a strong (6.8) and a major (7.0) earthquake. The seismic activities could be attributed to the NNW trending fault system in this area and volcanism. Statistically, the few number of observed seismic events in each period of observation is insufficient for data analysis. Physically, the strong and major events are of seismological concern.

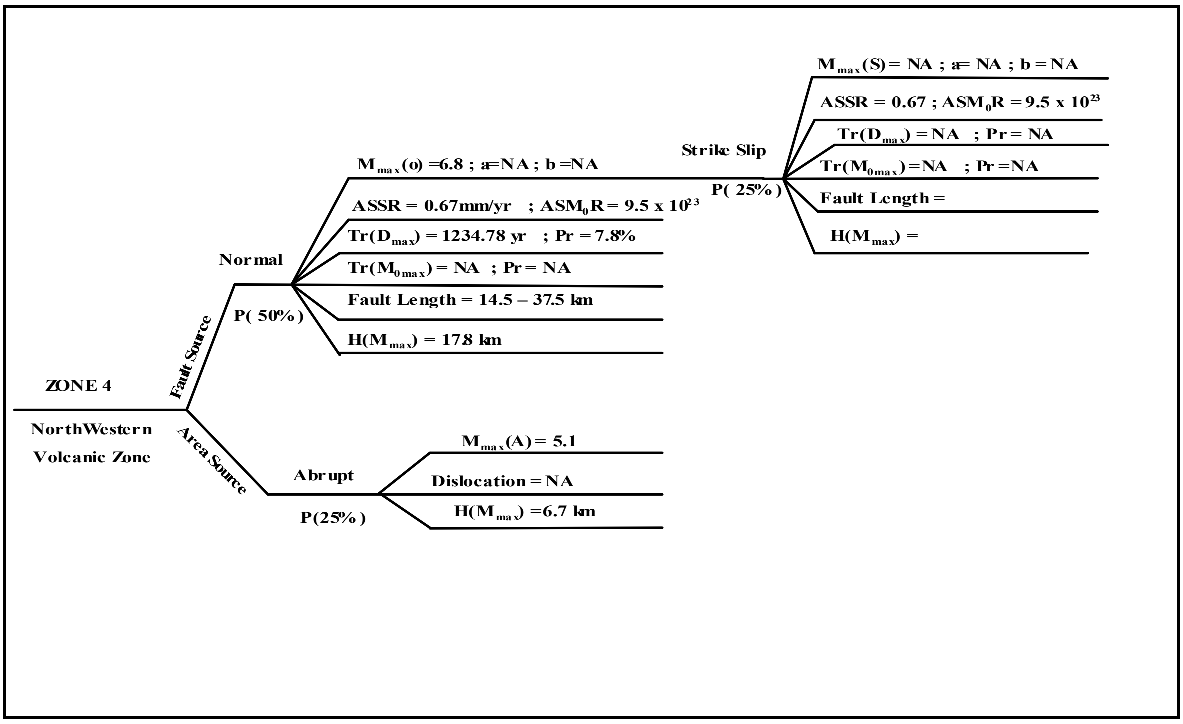


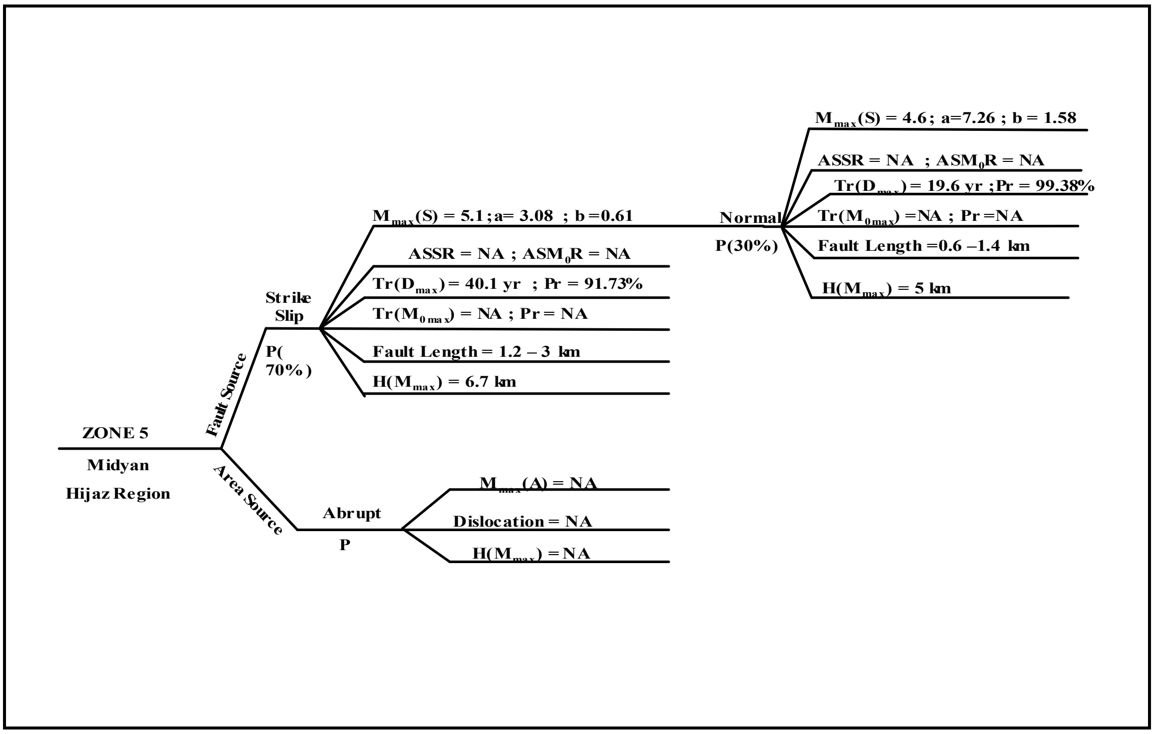
Zone 4 (Northwestern volcanic region)

This zone is a portion of the northwestern volcanic regions that includes the city of Al-Madinah. Its corner boundaries are defined in the accompanying table. Its approximate are is 98618 sq. km. Attributed to this zone were 2 historically recorded volcanic eruptions in 1256 and 1293 in the Harrat Rahat area. Two historical events of local nature were also the other activity.

Zone 5 (Midyan – Hijaz)

It covers the long narrow strip of the marginal rift system in the northwestern portion of Saudi Arabia. Its corner boundaries are defined in the table. Approximate area is 36638 sq. km. There is no historically documented perceptible earthquake in this zone. The seismic activity starts during the instrumental period of observation. Recent seismic activity indicates 5 events that could be due to the existing fault system in this area.





Zone 6 (Duba – Wajh)

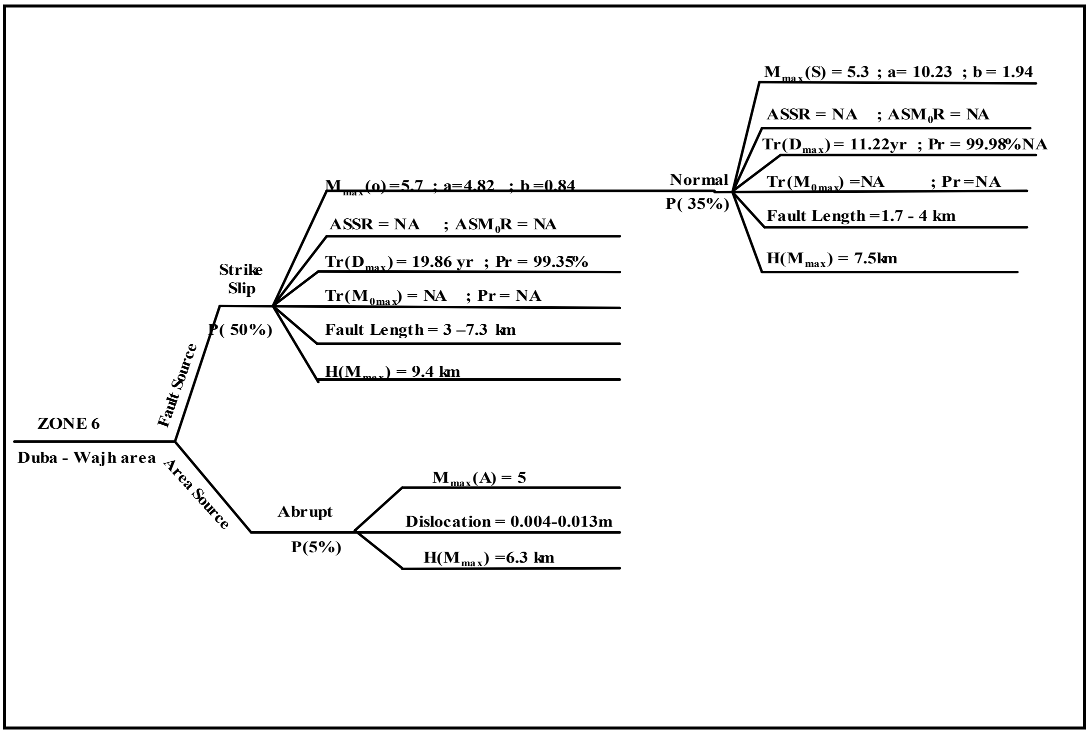
The location of this zone is in the northern Red Sea covering the cities of Duba and Wajh. Corner boundaries of this zone are as indicated in the table. Approximate area is 67476 sq. km. Attributed to this zone are 5 events during the historical period and 40 events during the instrumental period. Analysis was performed to the recent event data that gave b value within the range for rift zones. The events could be attributed to the presence of the NE trending transform faults, probably to high heat flow and triggering effects of the 1995 Aqabah quake.

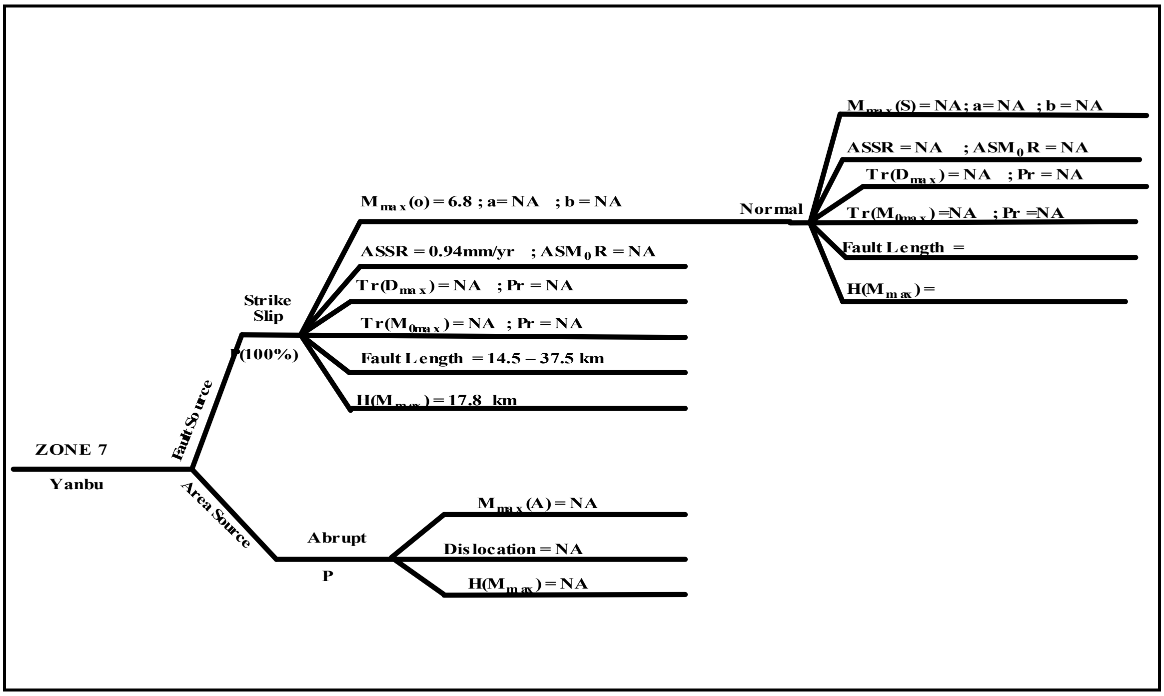
Zone 7 (Yanbu)

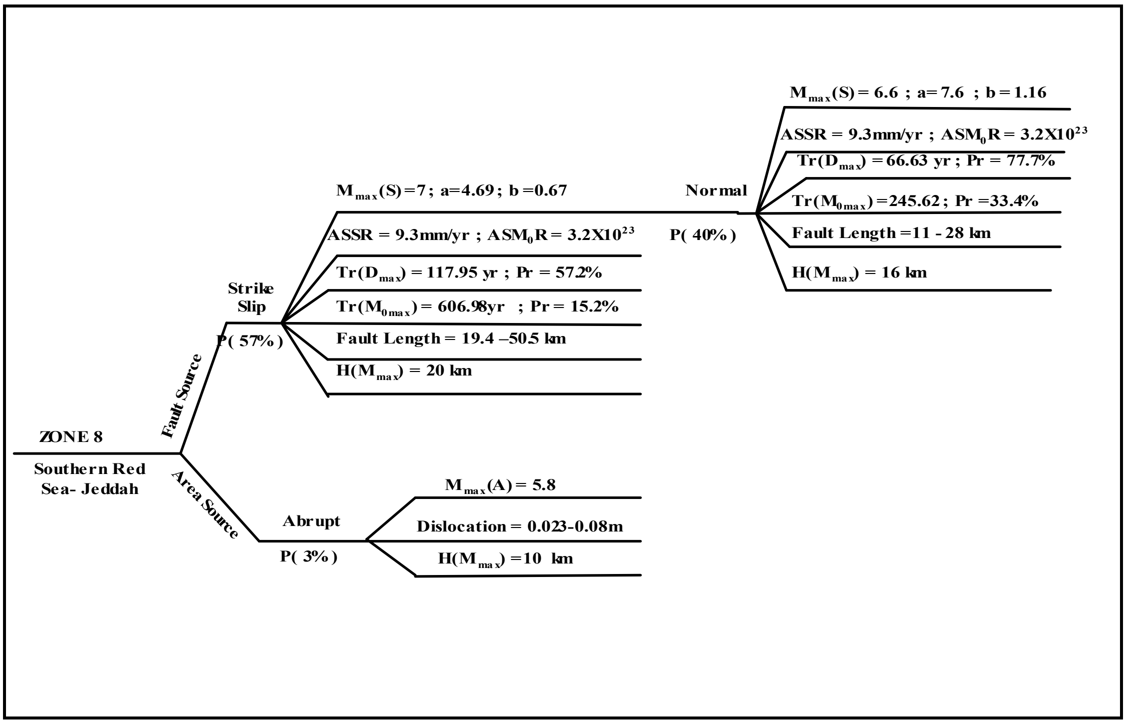
This zone is located in the central Red Sea covering the city of Yanbu. Its corner boundaries are described in the table. Its approximate area is 49614 sq. km. The only seismic activity attributed to this zone is in the historical period with magnitude of Ms=6.8. This event is placed in the NE trending transform fault located in this area.

Zone 8 (Southern Red Sea – Jeddah)

The location of zone 8 is in the southern Red Sea-Jeddah area. Its corner boundaries are as described in the table for this zone. Approximate area is 78009 sq. km. Seismicity in this zone is apparent for the whole period of observation. The seismic activity is indicated by the seismicity parameters to be increasing progressively in time for moderate events. Higher expectancy for the occurrences of moderate events are implied in the b-values obtained for the 2 later period of observation. The cumulative frequency-magnitude graph indicates a truncated estimate for Mmax under the instrumental period of observation. The seismic activity in this area could probably be due to the movements of the NE trending Ad-Damm fault and the intrusion of basic magma intrusion in the axial rift of the Red Sea (Fairhead and Girdler 1971).


ZONE 6
Duba - Wajh area
Fault Source
Area Source
Strike Slip
P(50%)
$M_{max}(o)$=5.7 ; a=4.82 ; b=0.84
ASSR = NA ; ASM_0R = NA
$Tr(D_{max})$= 19.86 yr ; Pr = 99.35%
$Tr(M_{0max})$ = NA ; Pr = NA
Fault Length = 3 –7.3 km
$H(M_{max})$ = 9.4 km
Normal
P(35%)
$M_{max}(S)$ = 5.3 ; a= 10.23 ; b = 1.94
ASSR = NA ; ASM_0R = NA
$Tr(D_{max})$= 11.22yr ; Pr = 99.98%NA
$Tr(M_{0max})$ =NA ; Pr =NA
Fault Length =1.7 - 4 km
$H(M_{max})$ = 7.5km
Abrupt
P(5%)
$M_{max}(A)$ = 5
Dislocation = 0.004-0.013m
$H(M_{max})$ =6.3 km


ZONE 7
Yanbu
Fault Source
Area Source
Strike Slip
P(100%)
$M_{max}(o)$ = 6.8 ; a= NA ; b = NA
ASSR = 0.94mm/yr ; ASM_0R = NA
$Tr(D_{max})$ = NA ; Pr = NA
$Tr(M_{0max})$ = NA ; Pr = NA
Fault Length = 14.5 – 37.5 km
$H(M_{max})$ = 17.8 km
Normal
$M_{max}(S)$ = NA; a= NA ; b = NA
ASSR = NA ; ASM_0R = NA
$Tr(D_{max})$ = NA ; Pr = NA
$Tr(M_{0max})$ =NA ; Pr =NA
Fault Length =
$H(M_{max})$ =
Abrupt
P
$M_{max}(A)$ = NA
Dislocation = NA
$H(M_{max})$ = NA

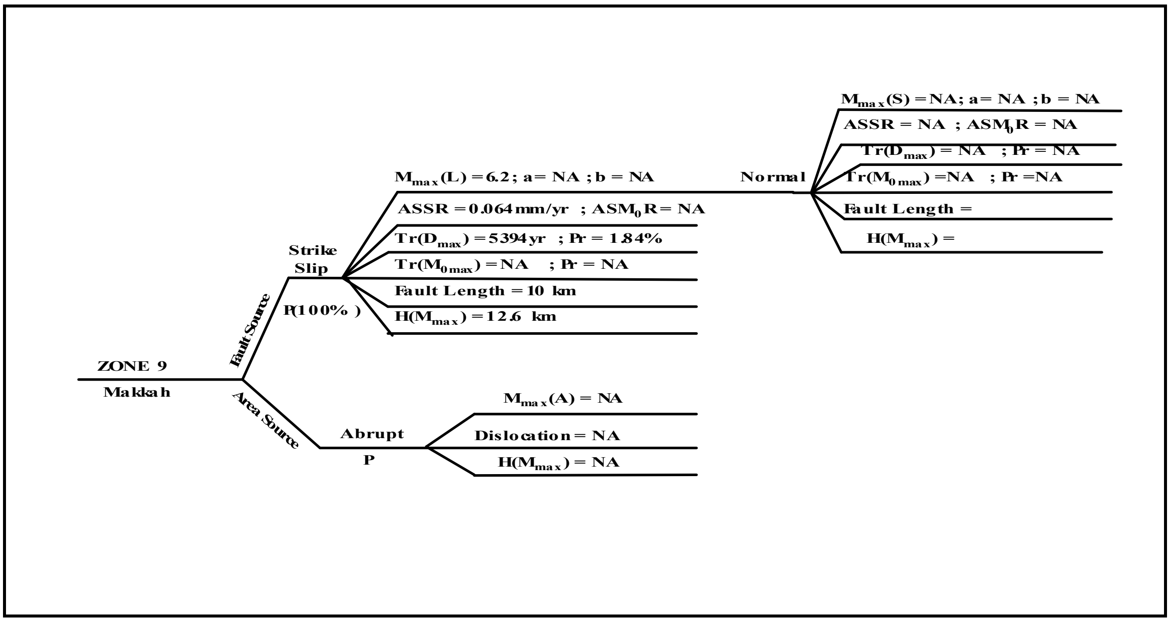


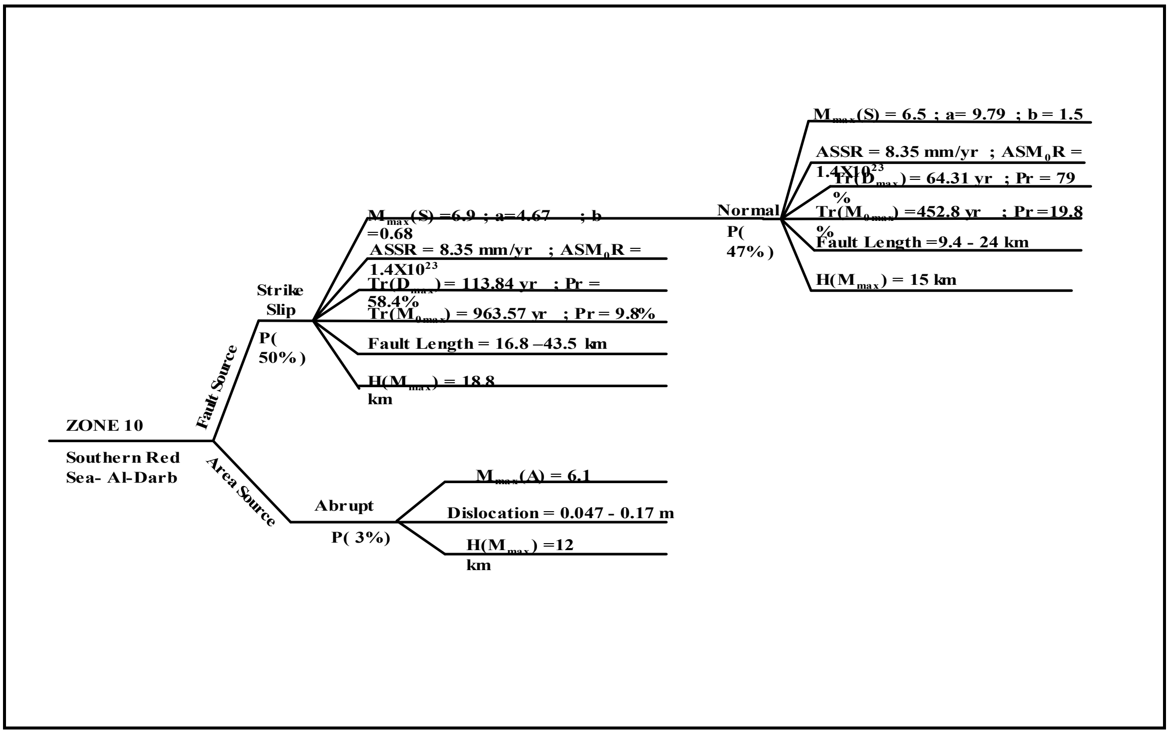
Zone 9 (Makkah)

This zone is located in the Makkah region. Its corner boundaries are described in the accompanying table for seismogenic source zones. Approximate area is 44958 sq. km. Two events of indefinite origin and one seismic event are documented for the historical period of observation, and one event in the instrumental period of observation. Probable causes of the events could be due to the movements of the NE trending Ad-Damm land fault in this area.

Zone 10 (Southern Red Sea – Al-Darb)

This zone covers the southern Red Sea-Al-Darb area. Its corner boundaries are shown in the accompanying table. Approximate area is 112358 sq. km. This zone has been seismically active for the whole period of observation. The range of the b-values suggests a moving-up trend as time progressively increases. The higher expectancy for the moderate events is in the recent activity, while for the large events are in the 2 earlier period of observation. Probable causes of the seismic activity in this zone could be the movements of the NE trending Ad-Darb transform fault and the basic intrusion of magmas in the axial rift of the Red sea as indicated by the presence of deep holes and high heat flow. The Ms= 7.7 for Mmax is an event of concern.





<u>**Zone 11 (Abha – Jizan)**</u>

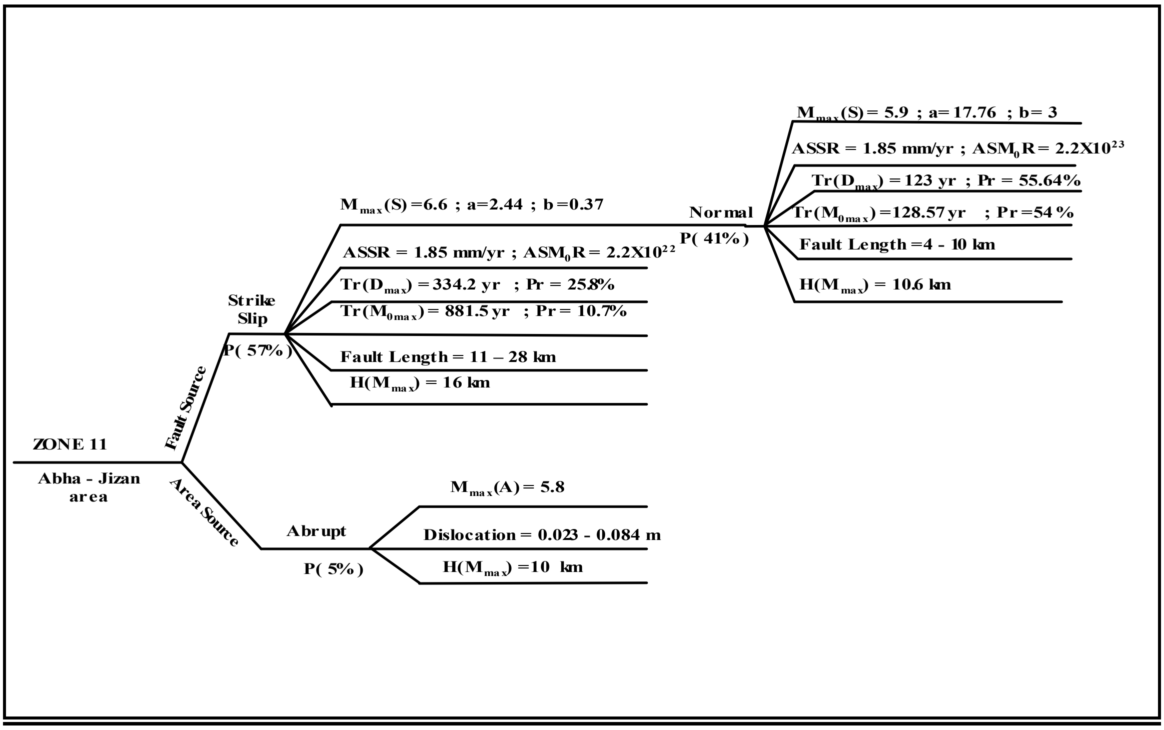
This zone is in the continental portion of Saudi Arabia encompassing the cities of Abha and Jizan. Its corner boundaries are indicated in the table. Approximate area is 44953 sq. km. The seismic activity in this zone is concentrated during the historical period., The activity tend to decline in the later period of observation. Probable cause of the events could be due to movements in the Abha syncline which is located in this area.

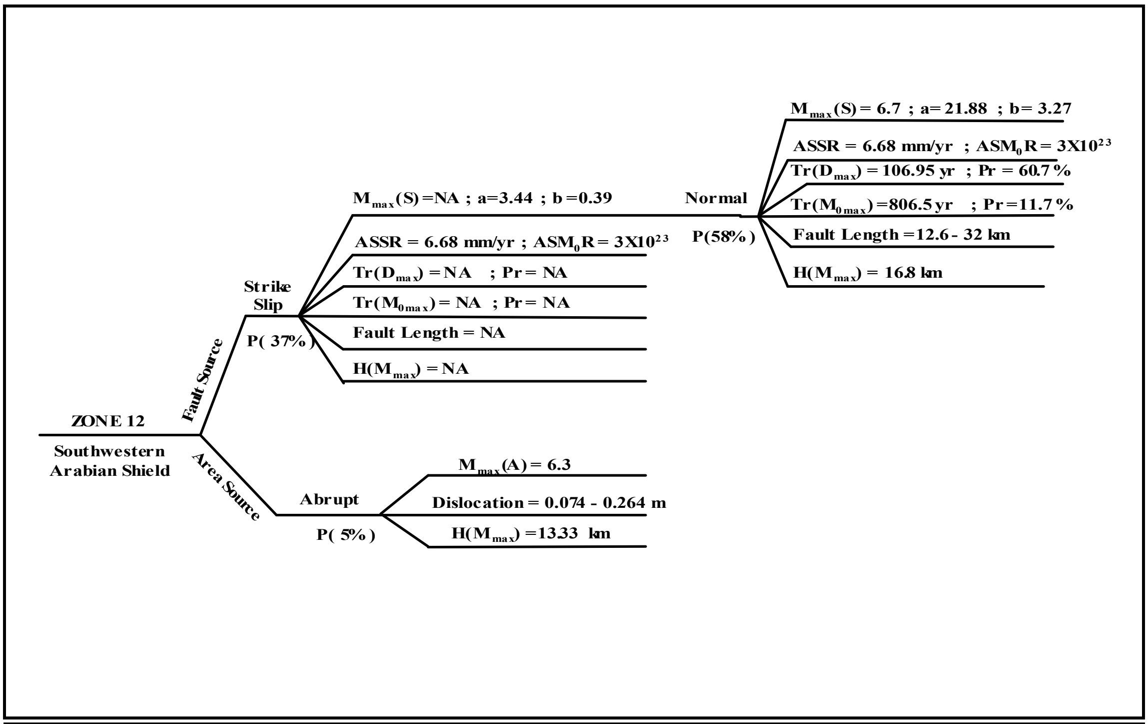
Zone 12 (Southwestern Arabian Shield)

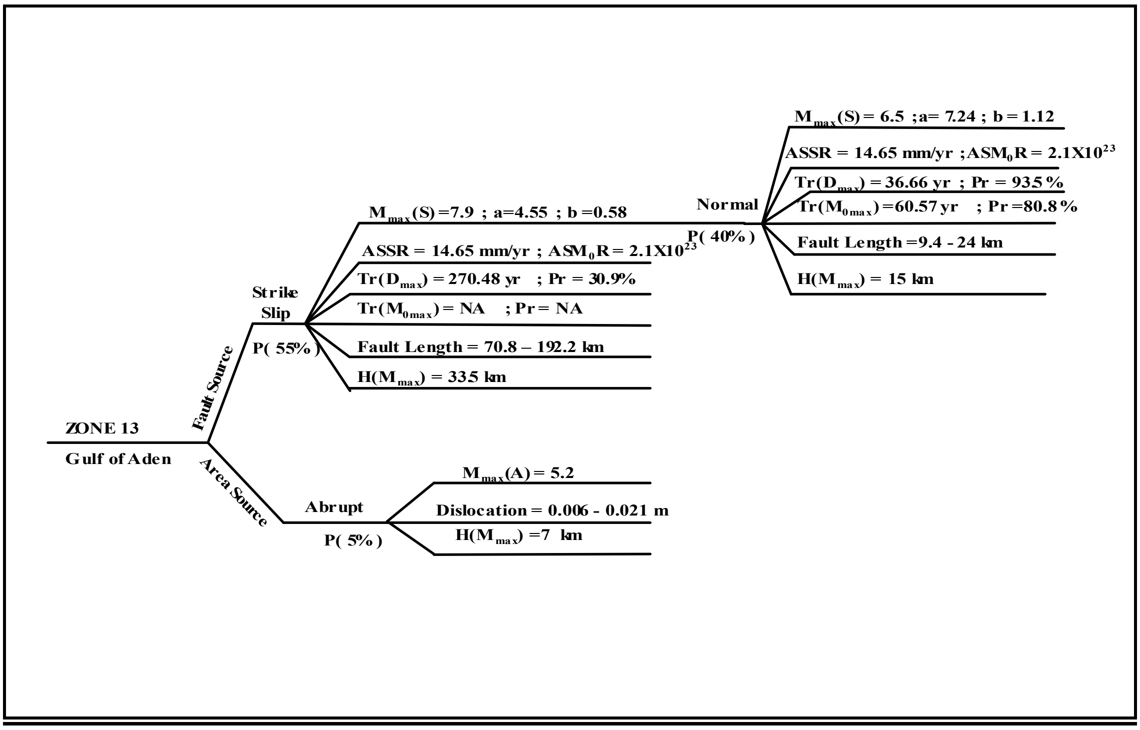
This zone is located in the southwestern Arabian Shield. The corner boundaries are as described in the accompanying table. Approximate area of coverage is 67323 sq. km. This zone is seismically active in the historical period of observation. The trend of seismicity is decreasing as time as time progresses. The b-values in the first 2 stages of observation indicate higher expectancy for large events. The highest observed magnitude in the historical period is a characteristic earthquake in the region. The Mmax for this period is estimated from the truncated distribution of the cumulative frequency. Probable causes of the seismic activity are the movements of the fault system in this area such as the Sadah fault.

Zone 13 (Gulf of Aden)

The location of this zone is in the gulf of Aden. Its corner boundaries are indicated in the accompanying table. Approximate area of coverage is 335351 sq. km. This zone is observed to be seismically active during the whole period of observation. The trend of the b-values for the 2 period of observation is increasing in time with the highest value obtained during the period 1965-1985. The data point set for the second period of seismic observation satisfy the assumed linearity of (4). Probable causes of the seismic activity in this area could be associated to the rifting processes that the gulf is undergoing.


ZONE 11
Abha - Jizan area
Fault Source
Area Source
Strike Slip
P(57%)
M_{max}(S) =6.6 ; a=2.44 ; b=0.37
ASSR = 1.85 mm/yr ; ASM_0R = $2.2X10^{22}$
Tr(D_{max}) = 334.2 yr ; Pr = 25.8%
Tr(M_{0max}) = 881.5 yr ; Pr = 10.7%
Fault Length = 11 – 28 km
H(M_{max}) = 16 km
Normal
P(41%)
M_{max}(S) = 5.9 ; a= 17.76 ; b= 3
ASSR = 1.85 mm/yr ; ASM_0R = $2.2X10^{23}$
Tr(D_{max}) = 123 yr ; Pr = 55.64%
Tr(M_{0max}) =128.57 yr ; Pr =54 %
Fault Length =4 - 10 km
H(M_{max}) = 10.6 km
Abrupt
P(5%)
M_{max}(A) = 5.8
Dislocation = 0.023 - 0.084 m
H(M_{max}) =10 km


ZONE 12
Southwestern Arabian Shield
Fault Source
Area Source
Strike Slip
P(37%)
M_{max}(S) =NA ; a=3.44 ; b =0.39
ASSR = 6.68 mm/yr ; ASM_0R = $3X10^{23}$
Tr(D_{max}) = NA ; Pr = NA
Tr(M_{0max}) = NA ; Pr = NA
Fault Length = NA
H(M_{max}) = NA
Normal
P(58%)
M_{max}(S) = 6.7 ; a= 21.88 ; b= 3.27
ASSR = 6.68 mm/yr ; ASM_0R = $3X10^{23}$
Tr(D_{max}) = 106.95 yr ; Pr = 60.7 %
Tr(M_{0max}) =806.5 yr ; Pr =11.7 %
Fault Length =12.6 - 32 km
H(M_{max}) = 16.8 km
Abrupt
P(5%)
M_{max}(A) = 6.3
Dislocation = 0.074 - 0.264 m
H(M_{max}) =13.33 km



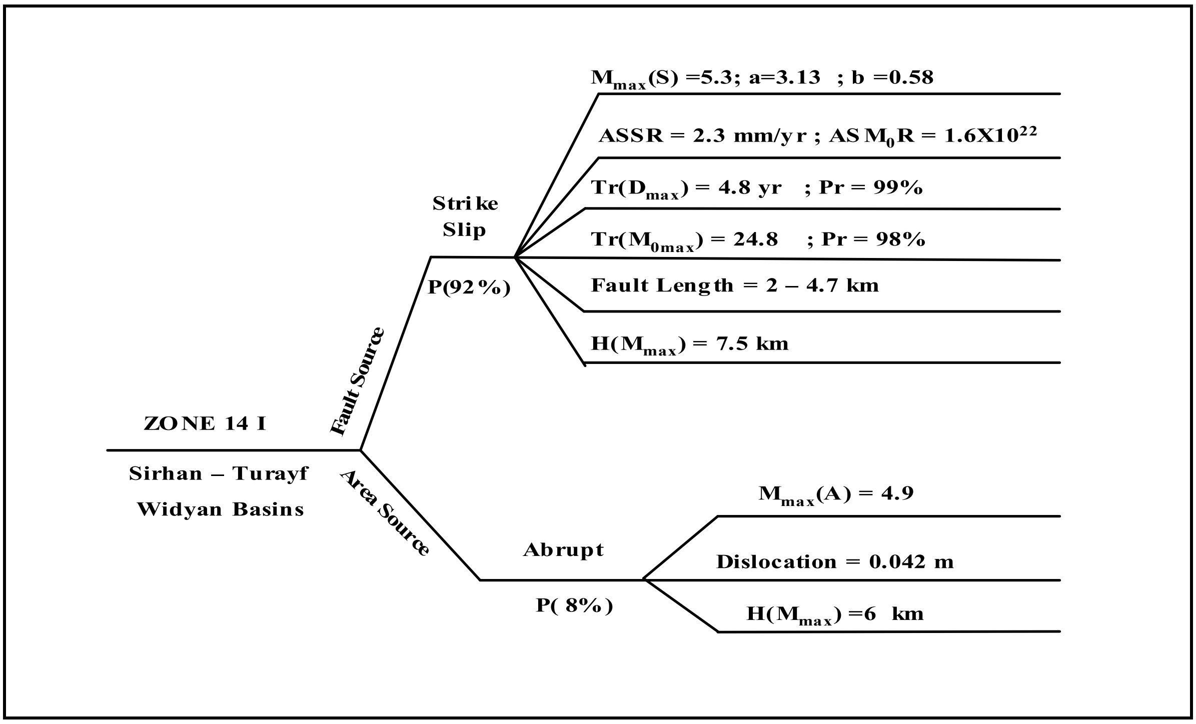
Zone 14 (Sirhan-Turayf-Widyan Basins)

The tectonic units composing Zone 14 are: Harrat al Harrah, Umm Wuai graben, Wadi as Sirhan and At Tawil faults, Sirhan At Turayf and Widyan basins. During the late Triassic to early Jurassic, rifting occurred at the northern end of the Arabian plate. A new Neo-Tethys was created. A north trending seaway developed which is possibly a successor of the Paleozoic Widyan basin. In the late to middle Jurassic, a limited Palmyrid-trend rifting occurred and the extrusion of the Devora volcanics was concurrent with the tectonic activity. During the late Jurassic, the Levant region also shows uplift and rifting coincident with massive Tayasir volcanism that could be responsible for the formation of Harrat al Harah. Early Senonian uplift and inversion of older structures in the Levant caused deformations along the Syrian arc and the onset of faulting in the Azraq Graben in Jordan with possible extension in northern portion of Saudi Arabia. A major basin evolved into the Azraq graben, a part of which could be the Sirhan at Turayf basin.

Historical data shows that there is one event of magnitude 5 located at coordinates 32N, 36E, and another one of magnitude 4 at 30N, 42.5E. The locations of these events seem to indicate that the first is generated by the Dead Sea transform fault, while the latter is within the vicinity of the Widyan basin.

Epicentral locations of instrumental data show that most of these are concentrated on Harrat al Harrah. However, the magnitude ranges of these events are from 2.5-3.8. The other events are scattered within the vicinity of Sirhan-Turayf and Widyan basins, and Wadi as Sirhan and At Tawil faults. The maximum magnitude of 5.4 in March 31, 1989 was observed to have occurred at Harrat al Harrah which could probably be due to fractures within the lava field.

Statistical analysis of the instrumental data using the cumulative frequency-magnitude relation show that the seismicity parameters have respective values as follow: a = 3.13: b = -0.58; Mmax = 5.3. The historical data is insufficient for statistical treatment. A brief summary and description for the seismotectonic correlation for this seismogenic source zone is graphically shown by the accompanying cumulative frequency-magnitude relation and logic tree diagram.

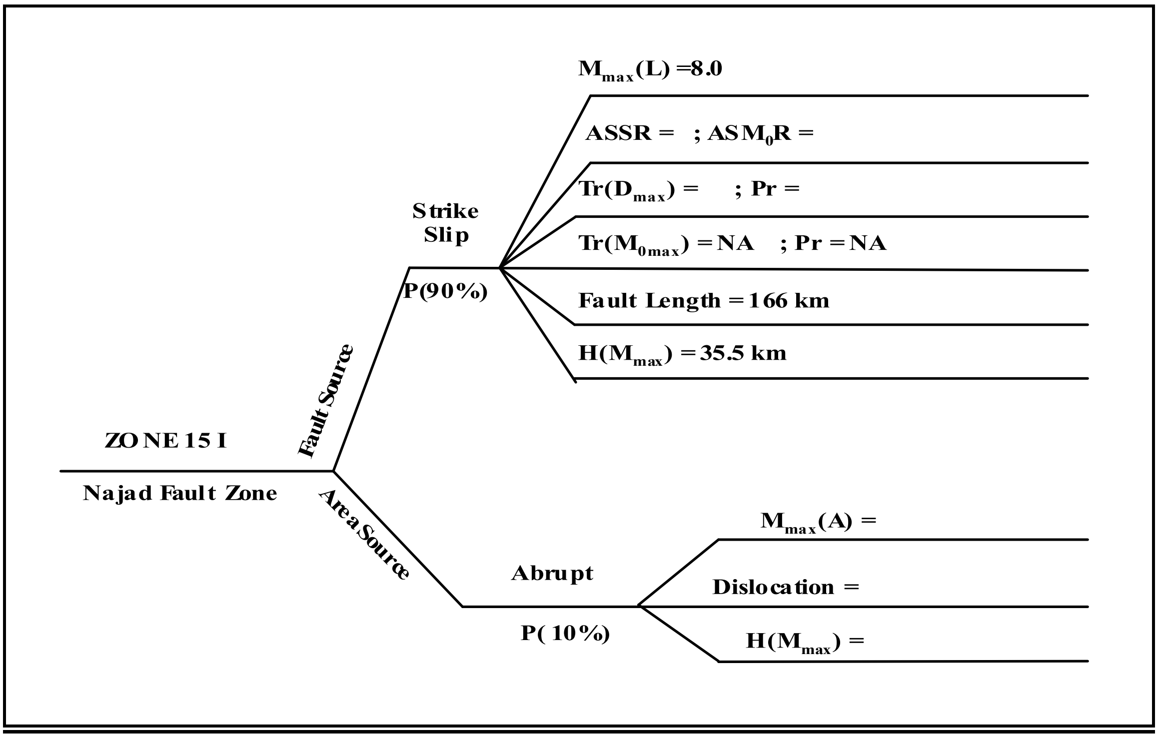


Zone 15 (Najd Fault Zone)

The major tectonic component of Zone 15 is the Najd fault system. The north, northeast, and northwest trending pattern of the faults, anticlines, and arches in central and eastern Saudi Arabia appears to have formed in two tectonic stages. These are the Precambrian Amar Collision between 640-620 million years ago (Ma), followed by the development of the Najd Rift System between about 570-530 Ma (Stoeser & Camp 1985). The Amar collision was between the Afif and Ar Rayn terrane. The collision took place along the north trending Al Amar Idsas Suture bounded approximately from 22-25 degrees north and 43-45 degrees east whose longitudinal extension could be up to 29 degrees north based from aeromagnetic map and possibly as far as the Zagros suture (Johnson & Stewart 1994). The Afif terrane formed the eastern edge of a series of terranes (Midyan, Hijaz, Asir), while the Rayn micro-plate corresponds to central and eastern Arabia and is bounded to the west by the Al-Amar island arc. Following the Amar collision, the entire Arabian-Nubian Shield appears to have started collapsing in extension. The extensional collapse culminated in the development of the regionally extensive Najd Fault System and its complimentary rift basins that make up the Najd Rift System.

The sinistral Najd fault system consists of three main parallel fault zones, each about 5-10 km wide, that dislocated the much older (680-640 Ma) Nabitah Suture by approximately 250-300 km (Brown et al 1989). The fault system has a width of about 300 km and an exposed length of 1,100 km. The dislocation on the Najd west (Ruwah, Ad Dafinah, Nabitah), central (Ar Rika), and east (Halaban-Zarghat) faults are about 120-150 km, 80-100 km, and 50 km respectively (Brown et al 1989). The fault movement was brittle and the plate motion along the faults was kinematic (Moore 1979). In the subsurface, the Najd fault system extends across the western Rub Al Khali basin as interpreted from seismic, gravity and magnetic data. Pull-apart basins that align with the Najd fault system show syn-rift layered seismic reflections and salt structures (Dyer and Al-Husseini 1991; Faqira and Al-Hauwaj 1998).

No historical seismic events were observed to have occurred in this zone, and only 5 instrumental earthquakes were compiled. The observed maximum magnitude was 4.4 which had occurred in Nov. 6, 1997 in the vicinity of Kirsh gneiss and Ar Rika fault zone. The second event of lesser magnitude has a value of 4, occurring in Aug. 17, 1997 also within the vicinity of the Ar Rika fault zone. Since there are only 5 seismic events, the Utsu-Aki maximum likelihood was utilized in the evaluation of the values of the seismicity parameters. The obtained values of the seismic parameters are: a = 3.69; b = -0.74; Mmax = 4. However, the estimated maximum magnitude from the seismicity parameters may not be the appropriate value should dynamic dislocations from the 3 faults in this zone occur. Assuming an average fault length of 166 km, the equivalent magnitude for this fault length is 8.0 as obtained from equation (1).



Zone 16 (Central Arabian Graben Zone)

Zone 16 is roughly composed of the central Arabian graben and trough system; Wadi Batin and Abu Jifan fault; Summan platform, Khurais- Burgan and En Nala-Ghawar anticlines, Qatar Arch, and the Kuwait complex structures ranging from megascale, mesoscale, and microscale. The approximately 560 km compound graben system defines an arc concave to the northeast. It comprises six (6) major grabens and three (3) large synclinal troughs, together with subsidiary grabens and troughs. The major grabens are Majma, Al Barrah, Qaradan, Durma, Awsat, and Nisah. The Durma, Awsat, and Nisah lie entirely within the present region, which also includes 4 km of the eastern end of the Qaradan graben. The Majma, Awsat and Nisah grabens are compound structures. The Majma graben comprises many offset segments, whereas, the Awsat and Nisah grabens each consists of two overlapping segments. The three

(3) large troughs are Buayja, Mughrah, and Sahba. Mughrah trough and the Maraghah monocline defined as separate structures.

Graben boundaries are defined high-angle normal faults commonly cutting the steep limbs of associated inward-facing monoclinal flexure zones. Trough margins are defined by inward-facing monoclinal flexures locally accompanied by subsidiary normal faults. Many grabens die out laterally through monoclinal flexures of decreasing amplitudes.

On the basis of stratigraphic and facies relationships, Powers et al., (1966) proposed that faulting on the central Arabian graben and trough system began in the Late-Cretaceous time and may have continued until the Eocene. The grabens developed between Late Cretaceous and the Late Quaternary, most movement being Paleogene age but succeeded by subsidiary Neogene and Quaternary movements.

Three (3) west-facing escarpments arranged in concentric arcs concave to the west dominate the topography. The western and highest escarpment, Jabal Tuwayq, is a double scarp. The western end is capped by the Tuwayq Mountain Limestone and the eastern end is capped by the Jubaila Limestone. The eastern end is the Jubayl escarpment capped of the Sulaiy Formation. The Durma basin lies west of the Tuwayq escarpment and the Kharj basin is situated between the Tuwayq and Al Jubayl escarpments.

The approximately 140 km Majma graben complex comprises many overlapping faults and en-echelon grabens replacing one another. The first is to the west and then to the east as the structure is traced from south to north (Powers et al 1966).The southern segment trends 340 degrees, while the northern segment trends 356 degrees. Displacement on their boundary faults range from 150-200 m. From south to north , the graben complex cuts outcrops from the Dhruma formation to the Aruma formation. The 23 km Al Barrah graben trends 305 degrees. Displacements on its boundary faults are estimated to range from 200 – 300 m (Powers et al 1966). The graben is expressed by a relatively low dissected ridge that mainly exposes the Tuwayq Mountain limestone. The approximate length of the Durma-Nisah segment of the central Arabian graben system is 150 km and its width is about 25 km. The Nisah, Awsat, Durma, and Qaradan grabens are arranged en echelon. The Awsat and Nisah grabens are compound, each comprises two overlapping segment, the sense of overlap being the opposite of that displayed by the four grabens. Fault zones along graben margins commonly comprise a principal boundary fault, subsidiary antithetic or synthetic normal faults, and minor antithetic or synthetic extension faults, that is, small faults that result in layer-parallel elongation (Norris 1958).

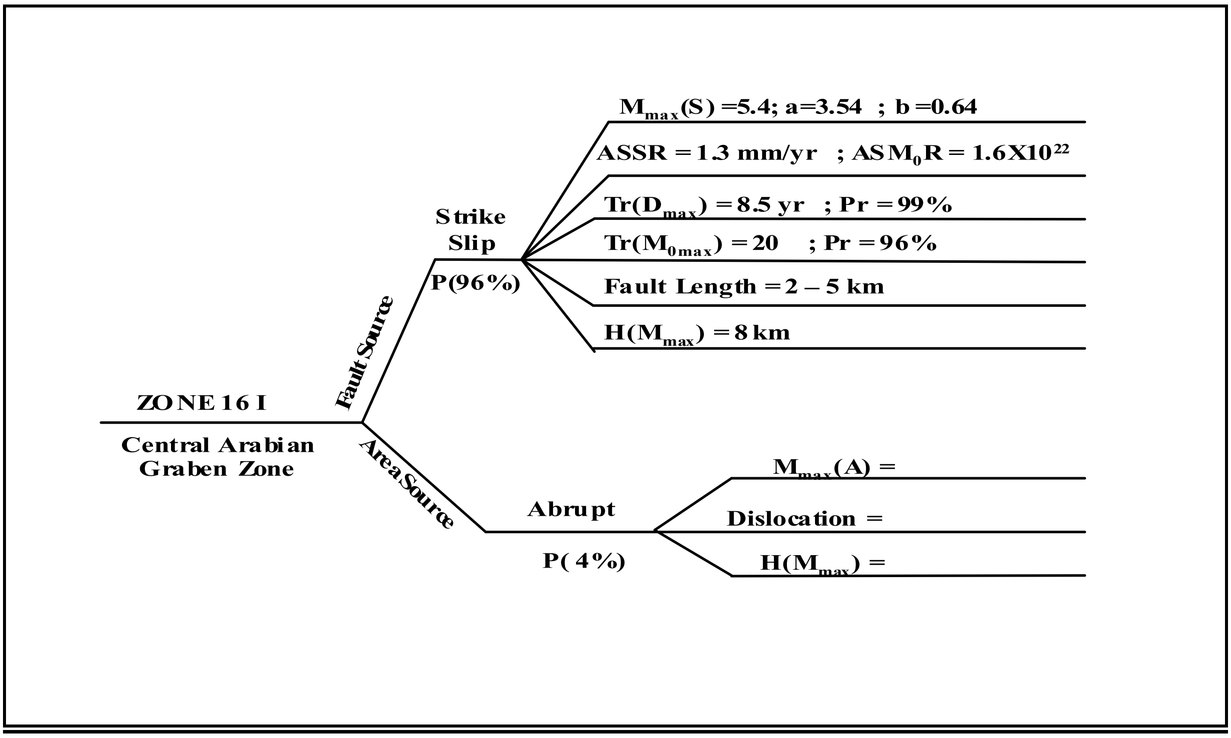
The Qaradan graben is at least 12 km long and an average of 2.5 km width. The graben trends 310 degrees and its displacement on its boundary faults exceeds 400 m in the northeast. According to Powers et al (1966), the Qaradan graben is separated from the Durma graben by transverse fault striking 290 degrees. The exposed length of the Durma graben is about 63 km. Its width is from 1-1.5 km. It trends 295 degrees. Displacements on the boundary faults increases progressively westward. A few meters at the eastern end of the graben to about 100 m near longitude 46 degrees 27 minute east, 330 m near longitude 46 degrees and 17 minutes east, and about 400 m at the western end of the graben. The Awsat graben can be traced for about 90 km. It comprises two segments each 1-2 km wide. Powers et al (1966) recorded an overlap of about 7 km, while present mapping shows the overlap of the graben boundary faults is about 25 km. The eastern segment lies north of the western segment Displacement on the high angle normal boundary faults are about 20-30 m close to the extreme western end of the structure, 200 m near (46 degrees, 8 minutes east), 300 m in the central section (46 degrees, 33 minutes east), and decline to about 50 m at the eastern end.

The Nisah graben is about 95 km in length and comprises two segments overlapping around 4 km along a common boundary fault near 46 degrees, 36 minutes east. The 1.5-2.5 km wide western sement trends 290 degrees at it western end and 280 degrees at its eastern end. The eastern segment which is 2.5-3.5 km wide trends 275 degrees. The Buayja trough is approximately 40 km in length. In the west, it is about 1 km wide and broadens to about 3 km in the east. Along most of its length, the trough forms a shallow topographic depression crossed by transverse wadis. The Mughrah trough is about 40 km long to the east from 47 degrees and 19 minutes east. It has a gentler fold than the Buayja trough. The structural homolog of the Nisah graben east of longitude 47 degrees and 10 minutes east is the Sahba trough. It has a broad structural and topographic depression of about 8 km wide. According to Brown (1972), it is possible that this structure extends further east up to the Arabian Gulf.

Seismicity of the area has been studied mainly on the data from the Seismic Studies Center (SSC) of King Saud University, the Bahrain Seismic Network (BSN), the Qatar Seismic Network (QSN), the Kuwait National Seismic Network (KNSN), and Ambraseys (1988) compilation. Historical data indicates that an earthquake of magnitude 5.8 - 6.0 was reported to have occurred in 1832 near the Al-Ghawar reservoir and Qatar arch. Instrumental data show that the Al-Ghawar area and its vicinity has experienced 86 earthquakes ($2.5<Md<5.4$) from 1965-1998. Most of these seismic events are located south to southeast of the Ghawar reservoir and the rest on the west of Qatar peninsula. Clusters of seismic events were also to occur in the Qassim area. Range of magnitude of these events is from 3 to 3.8. Instrumental seismicity indicates that an observed maximum magnitude of 5.3 has occurred in the vicinity of the central anticlines of the Arabian platform in June 1, 2002.

The seismicity of Kuwait reveals two main cluster of events. The first is around the Minagish-Umm Gudair oil field zone, and the second is around the Raudhatain-Sabriya oil field. The spatial correlation of earthquakes and oil fields suggest that the seismic events have been induced by oil production. The historical seismicity in this area indicates a magnitude 5.5 occurring north of Kuwait in Sept. 9, 1903.

The historical data for this zone shows insufficiency for the determination of seismicity parameters, while from the instrumental data the values of the seismicity parameters are as follows: a = 3.54; b = -0.64; and Mmax = 5.4



Zone 17 (Arabian Gulf)

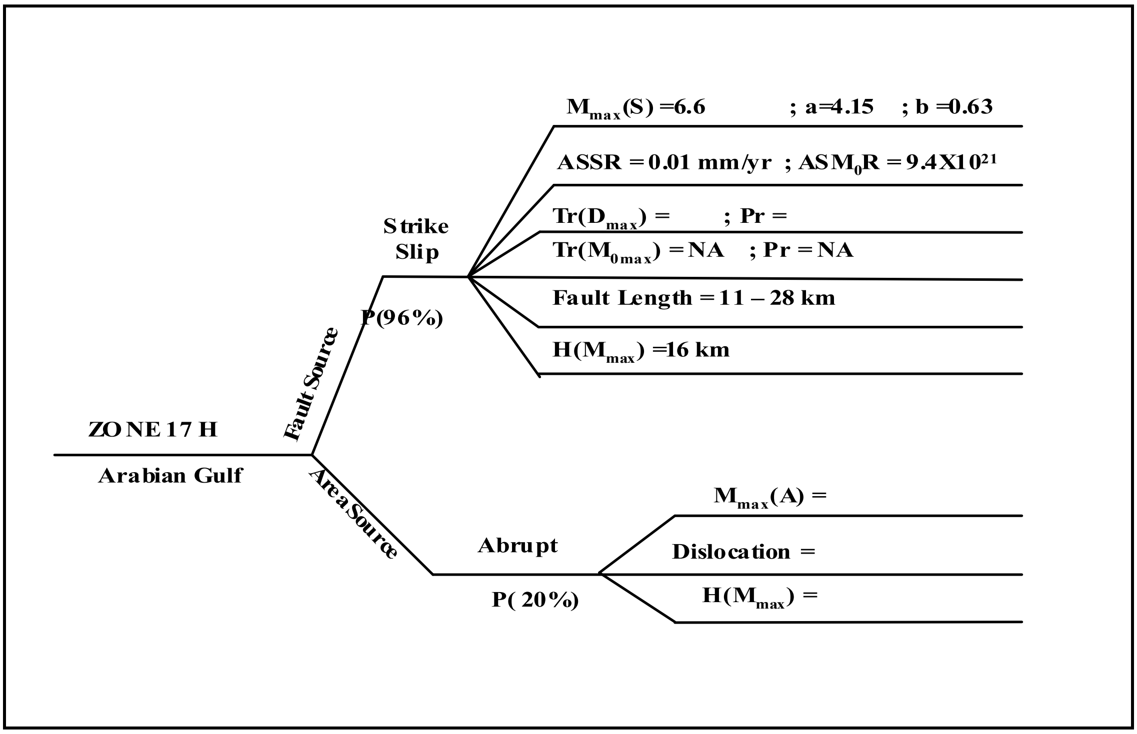
During the early to late middle Jurassic, the north trending Gotnia basin became established across the head of the Arabian gulf., possibly separated by the Rimthan arch from its southern extension, the Arabian basin. The Gotnia basin allowed direct access for the open Neo-Tethys far across the Arabian platform. In the middle Jurassic, incipient graben system with a northwesterly trend developed at the southern margin of the Arabian plate. They began as a terrestrial to continental infill of erosional lows or pre-rift structural depressions, and culminated as rift troughs containing shallow water carbonates in the middle Jurassic. At the beginning of the Cretaceous, global sea level was relatively high, and the remnant of the

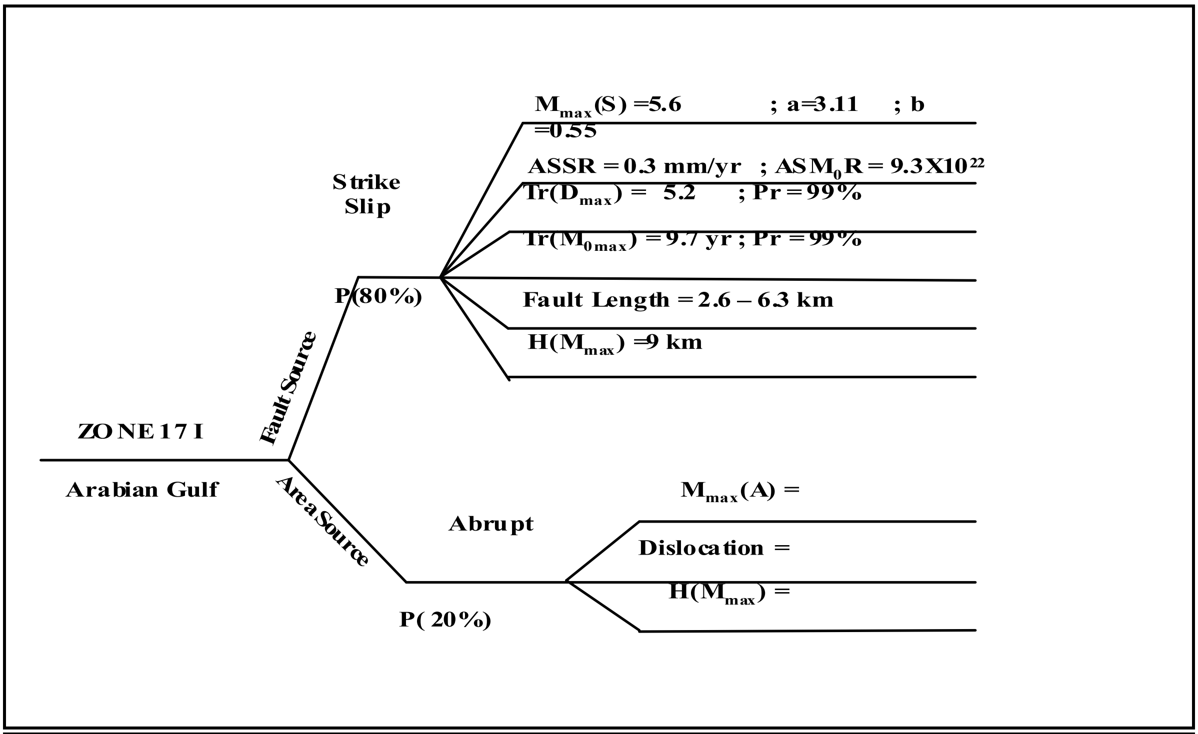
Gotnia basin underwent rapid subsidence in the eastern part. At the time of high sea level, a shallow epeiric sea inundated the eastern platform of the Arabian plate. During the late Paleocene to early Oligocene, the Hercynian structural trends of the central Arabian arch continued to modify the morphology of the foreland basins. This became progressively narrower as it was filled in, until it became structurally neutralized. During the Pleistocene, sea level was low, and east of the Arabian arch, the shallow epicontinental Arabian gulf began to take its present shape (Ziegler 2001).

The spatial distribution of epicenters shows a scattered location of earthquake events, except along the common boundary that separate Zones 17 and 18, where a thin line of NW trending concentration can be seen. The scattering seems to be distributed all over the basin. Some are located in the Zagros fold belt area that belongs to this zone. The Arabian gulf seismic zone is both historically and instrumentally active. A maximum magnitude of 5.9 is observed to have occurred in Aug. 16,1883 in the Zagros fold belt that belongs to the zone. A lesser event of magnitude 5.8 in

March 6, 1956 was located in the basin. Instrumental data indicates that two earthquakes occurring in Nov. 7 1969 and in Sept 13, 2000 with the same magnitude value of 5 have occurred in the Zagros folded belt of the zone

Statistical analysis was conducted for the two period of observation separately using the cumulative frequency-magnitude relation due to sufficiency of seismic data. The obtained values for the seismicity parameters from the historical data were: a = 4.15; b = -0.63; Mmax = 6.6; while for the instrumental data gives: a = 3.12; b = -0.55; Mmax = 5.6. A brief summary of the seismotectonic correlation for this source area is graphically provided by the accompanying cumulative frequency-magnitude relation and logic tree diagram.


ZONE 17 H
Arabian Gulf
Fault Source
Strike Slip
P(96%)
Mmax(S) =6.6 ; a=4.15 ; b =0.63
ASSR = 0.01 mm/yr ; ASM0R = 9.4X10^21
Tr(Dmax) = ; Pr =
Tr(M0max) = NA ; Pr = NA
Fault Length = 11 – 28 km
H(Mmax) =16 km
Area Source
Abrupt
P(20%)
Mmax(A) =
Dislocation =
H(Mmax) =


ZONE 17 I
Arabian Gulf
Fault Source
Strike Slip
P(80%)
Mmax(S) =5.6 ; a=3.11 ; b =0.55
ASSR = 0.3 mm/yr ; ASM0R = 9.3X10^22
Tr(Dmax) = 5.2 ; Pr = 99%
Tr(M0max) = 9.7 yr ; Pr = 99%
Fault Length = 2.6 – 6.3 km
H(Mmax) =9 km
Area Source
Abrupt
P(20%)
Mmax(A) =
Dislocation =
H(Mmax) =

Zone 18 (Zagros Fold Zone)

The primary tectonic unit in this source area is the folded zone of the Zagros Mountains. The Zagros mountains are a broad belt of NW-SE folded and faulted Paleozoic, Mesozoic, and Cenozoic rocks with orogenic movements occurring in Late Tertiary. Zagros mountain foreland is composed of gentle folded rocks, elongated, parallel and contemporaneous structure to the belt. The continued convergence of the Afro-Arabian plate relative to the Iranian blocks is partially accommodated by folding of the Zagros sedimentary cover and by high angle reverse faulting of the underlying Precambrian Arabian basement. The sedimentary cover is decoupled from the basement by the thick Infra-Cambrian Hormuz salt bed which acts as a detachment surface. The synchronous widespread deformation of the sedimentary cover and the basement is a unique feature for the Zagros region. The present basement faulting beneath the Zagros fold belt as due to re-activation of pre-existing normal faults as reverse faults in the Arabian continental margin is in conformity with assumption. Crustal models constrained by Bouger gravity anomalies indicate a dipping Moho about 1 degree to the northeast and increases to about 5 degrees near the Main Zagros Thrust (MZT). The Moho depth increases from 40 km beneath the leading edge of the foreland basins (Mesopotamian Deep and Arabian Gulf) to 65 km beneath the MZT.

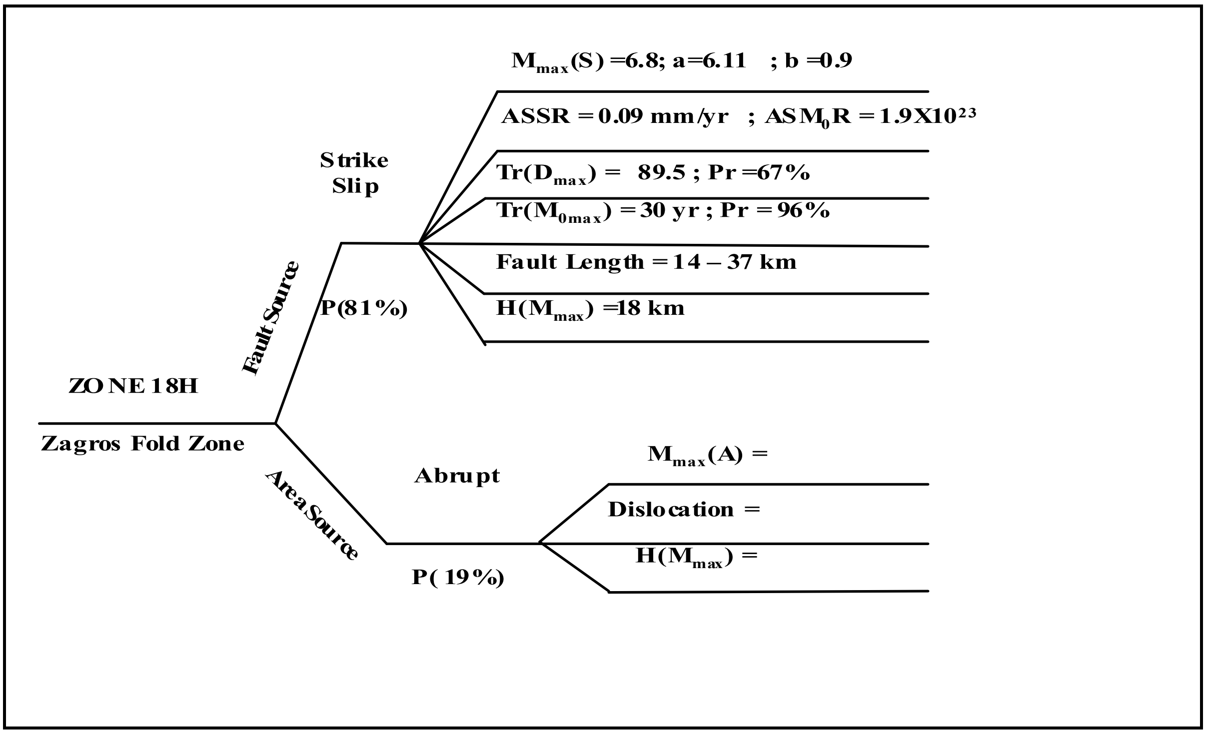
The entire Zagros folded belt is the most active seismic area in this seismogenic source zone. The folded zone is characterized by both shallow and non-shallow earthquakes. The earthquakes locations in this folded belt define a zone of about 200 km wide that runs parallel to its central axis. Most of the earthquakes are crustal seismic events that occur in the portion of the Arabian plate.

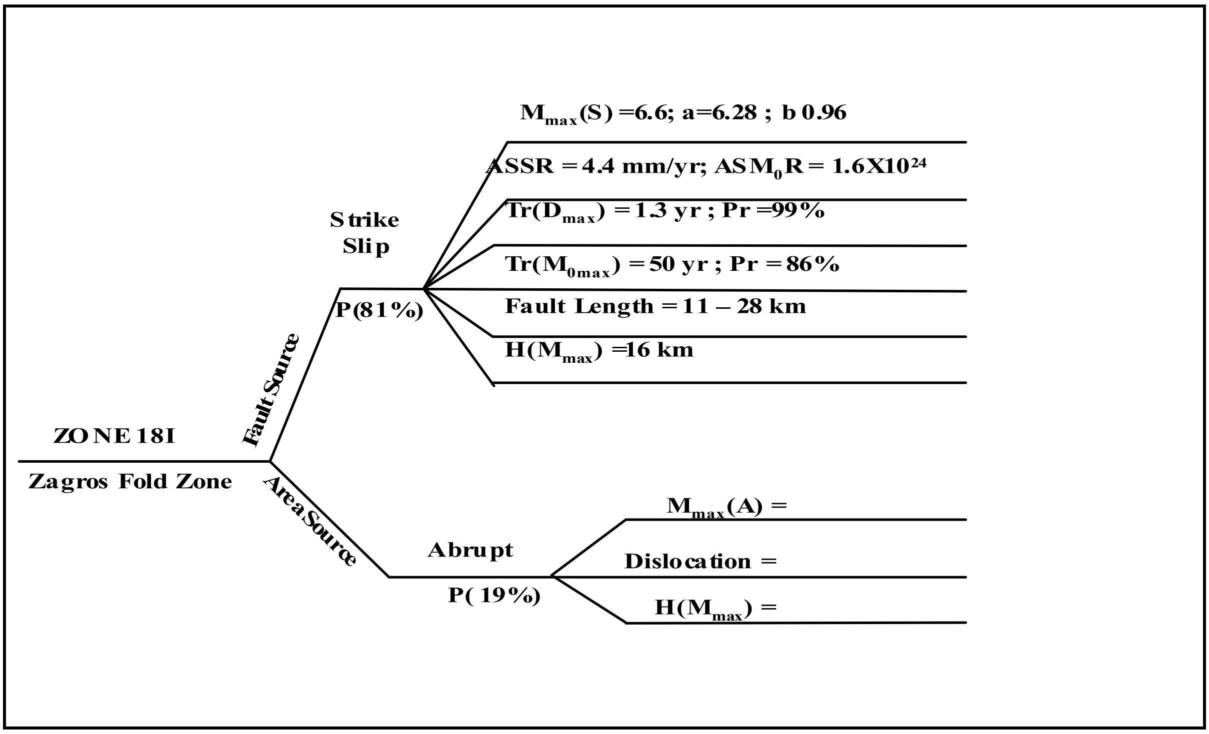
This seismogenic source zone is historically and recently active. Its historical data indicates that an earthquake of magnitude 5.7 has occurred in March 21 1875. One 5.5 magnitude in

Feb 4, 1934, and 3 magnitude 5.4 in 1925, 1939, and 1958 have occurred in this source zone. In 1972, a magnitude 6.1 has occurred which was followed by a magnitude 6 in 1976 in a span of 4 years. A survey of the range of magnitude in this zone is seen to be frequented many times with magnitude 5 and above.

Statistical analysis of the compiled seismic data using the cumulative frequency-magnitude relation gives values for the seismicity parameters for the historical period as: a = 6.11; b = -0.9; Mmax = 6.8; and for the instrumental data gives for a = 6.28; b = -0.96; Mmax = 6.6.

A brief description and summary of the seismotectonic correlation for this zone is shown by the accompanying frequency magnitude relation and logic tree diagram.



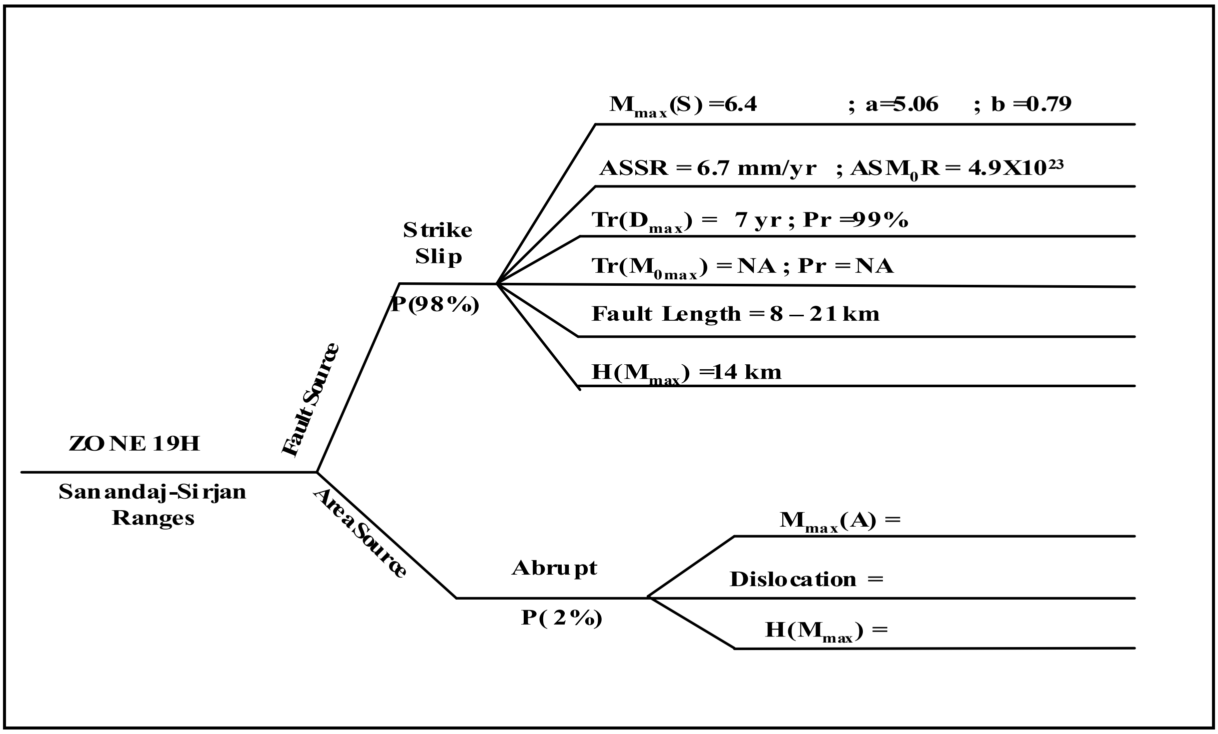


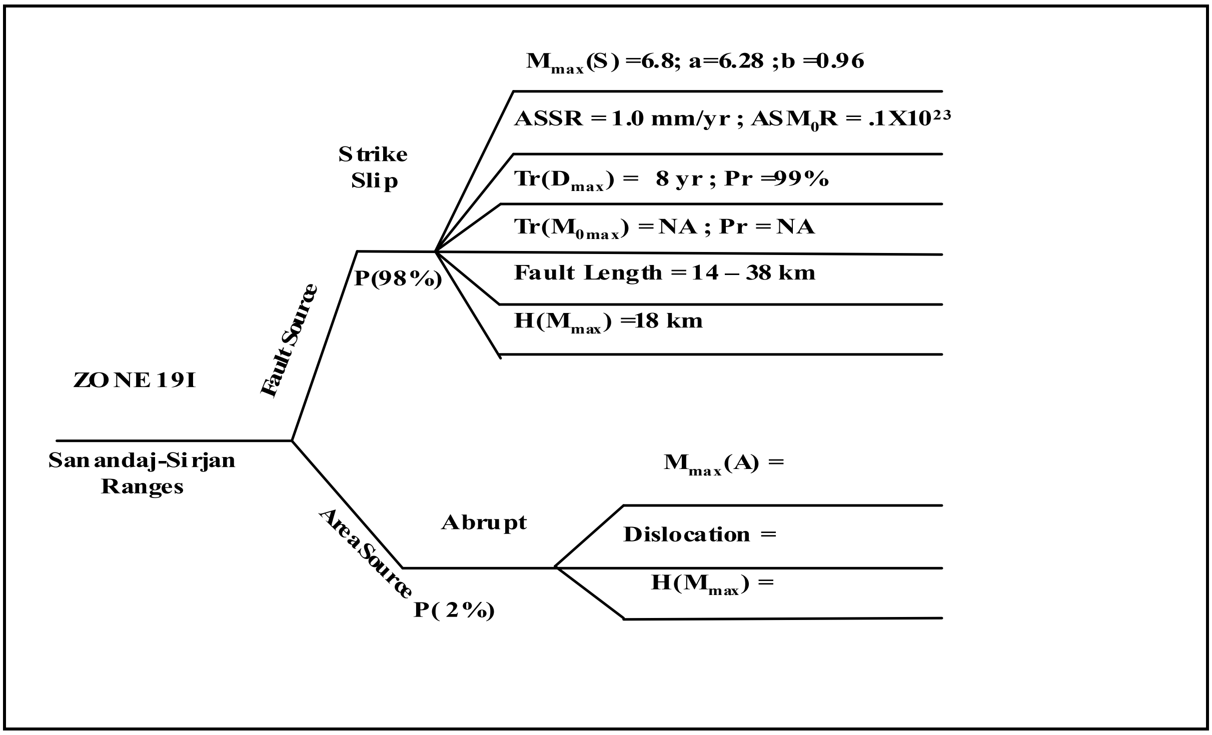
Zone 19 (Sanadaj-Sirjan Ranges)

The main Zagros thrust with its crush zone and the Sanandaj-Sirjan ranges are the principal tectonic units in this seismogenic zone. From the late middle Eocene to early Miocene, the Arabian plate began to impact southern Asia, and the Zagros oregeny began. In the late Permian, continental rifting and spreading took place along the present day Zagros suture as the Neo-Tethys ocean started to form. The former intra-shelf basins, Lurestan and Khuzestan in Iran have been consolidated to form one long relatively narrow foredeep trough along the Zagros fold belt. Close to the Zagros main thrust (MZT) silt and sandstones were deposited in the foredeep. Ophiolite nappes were emplaced along the MZT. During the Miocene, strong compression occurred as Arabia was driven into Eurasia. On the eastern flank of the Arabian plate, the thrusting of the Sanandaj-Sirjan zone onto the plate is evidence of the continental collision. As continent to continent collision continued, the Zagros oregeny intensified and thrust and folds belts migrated southwestward to their position in the Gulf region. Phases of compression led to the formation and deformation of the Zagros foredeep in front of the Zagros mountain belt. The Zagros foredeep (Mesopotamian basin) roughly corresponds to the zone between the Mesozoic unstable shelf to the west and the limit of the Zagros fold belt to the east.

The seismicity of this seismogenic source zone is governed mainly by two tectonic sources. These are the effects of underthrusting of the MZT by the Arabian plate and the convergence zone of southern Iran and Oman. However, the spatial distribution of earthquake epicenters in the MZT and the Sanandaj-Sirhan ranges is not as concentrated as the distribution in the Zagros folded belt and the convergence zone. Historically and recently this source area is seismically active. In May 2, 1963, a strong earthquake of magnitude 5.9 has occurred in the location of the MZT. From the historical data, it is seen that many seismic events of magnitude 5 and above have frequented this source area. In June 21, 1965 and in April 12, 1971 earthquakes of magnitude 6 have occurred. These two earthquakes are located near each other in the vicinity of the MZT and collision zone. It is also noted, that this period is frequented with seismic events whose magnitude values are 5 and above.

Statistical analysis conducted for the historical and instrumental data using the cumulative frequency-magnitude relation gives the following seismicity parameters values for a = 5.06; b = -0.79; Mmax = 6.4 of the historical data, and a = 6.28; b = -0.96; Mmax = 6.8 for the instrumental data. A brief summary of the seismotectonic correlation for this seismic zone is graphically shown by the accompanying frequency-magnitude relation and logic tree diagram.

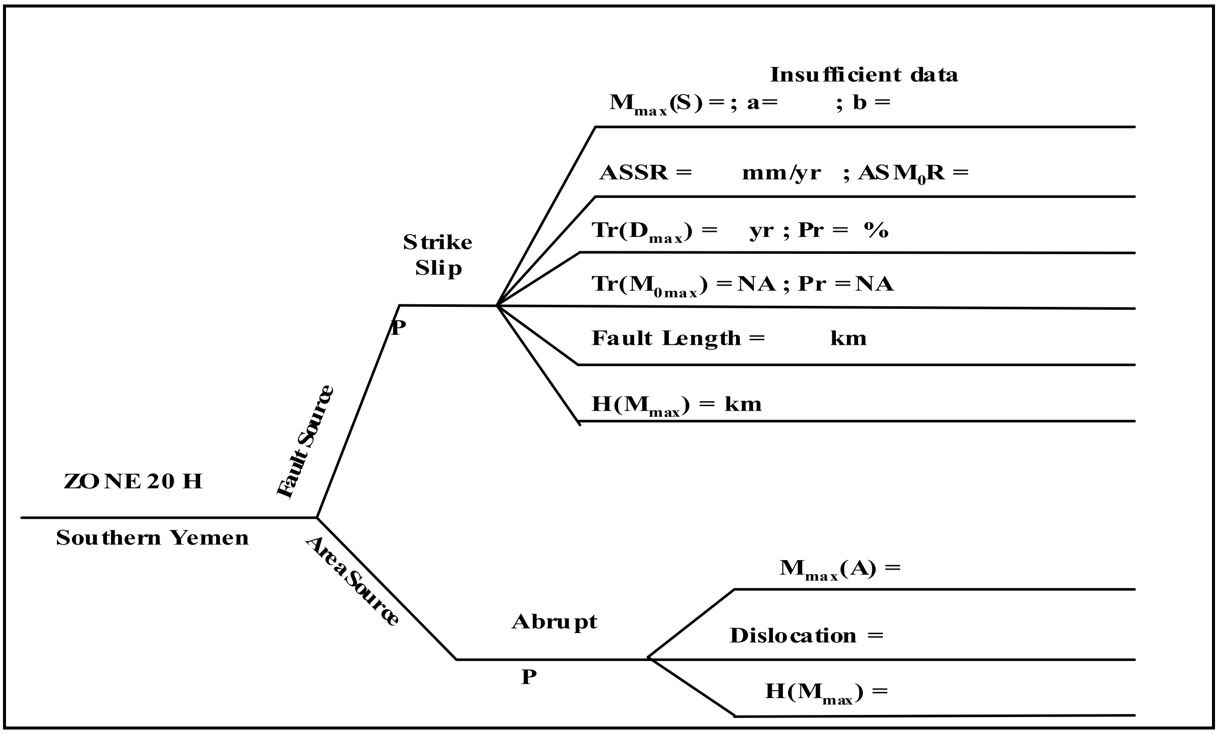

ZONE 19H
Sanandaj-Sirjan Ranges
Fault Source
Area Source
Strike Slip
P(98%)
$M_{max}(S)$ =6.4 ; a=5.06 ; b =0.79
ASSR = 6.7 mm/yr ; ASM_0R = 4.9X10^23
$Tr(D_{max})$ = 7 yr ; Pr =99%
$Tr(M_{0max})$ = NA ; Pr = NA
Fault Length = 8 – 21 km
$H(M_{max})$ =14 km
Abrupt
P(2%)
$M_{max}(A)$ =
Dislocation =
$H(M_{max})$ =

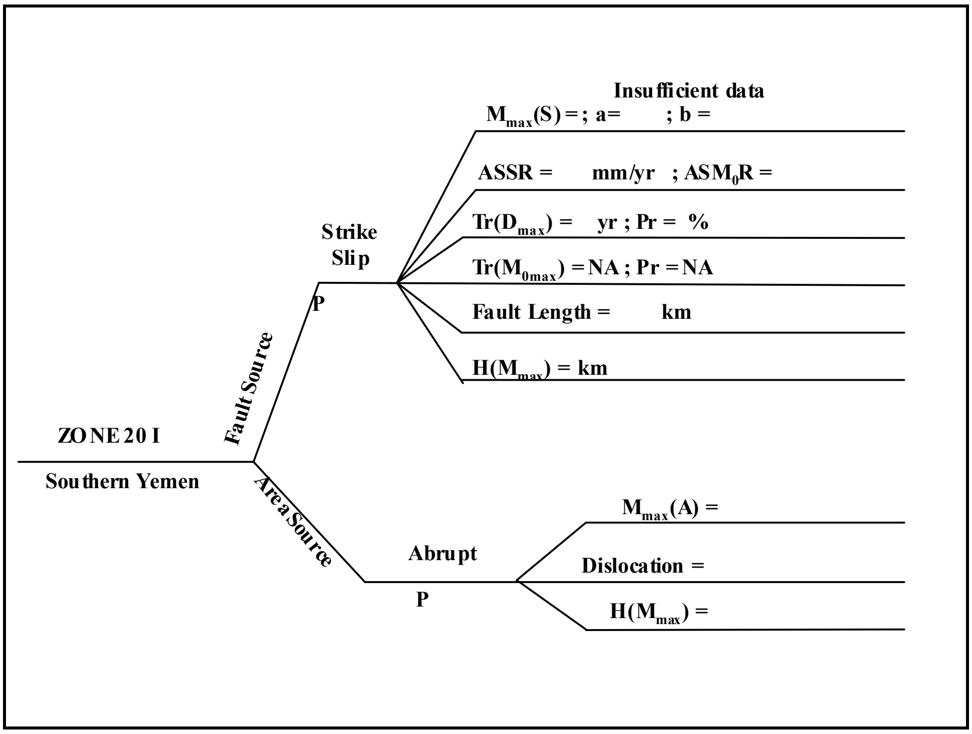

ZONE 19I
Sanandaj-Sirjan Ranges
Fault Source
Area Source
Strike Slip
P(98%)
$M_{max}(S)$ =6.8; a=6.28 ;b =0.96
ASSR = 1.0 mm/yr ; ASM_0R = .1X10^23
$Tr(D_{max})$ = 8 yr ; Pr =99%
$Tr(M_{0max})$ = NA ; Pr = NA
Fault Length = 14 – 38 km
$H(M_{max})$ =18 km
Abrupt
P(2%)
$M_{max}(A)$ =
Dislocation =
$H(M_{max})$ =

Zone 20 (Eastern Yemen)

The Marib-Shabwa basin is a west northwest-east southeast trending late Jurassic rift system which lies in southwestern Yemen. The orientation of the system corresponds to the Najd trend which probably exerted some control on the orientation of the Jurassic rift. It is part of an extensive system of basins which trend across southern Arabia and the Horn of Africa. To the east, the system extends almost to the island of Socotra. The structural framework of the Marib-Shabwa basin was established in Kimmeridgian-Tithonian times when the major period of rifting occurred. The rift widens considerably in the Shabwa area, and an important north-south (Hadramaut Trend) lineaments, such as the Shabwa arch and the Ayadin fault are present. This trend may be inherited from an underlying Proterozoic arc terrane suture. The Marib-Shabwa basin can be subdivided into several linked grabens and half-grabens. Basin geometry exercised a profound control on sedimentation by the central Marib-Shabwa basin both during syn-rit and post rift times. During syn-rift times, the deep half-grabens on the basin margin and adjacent to the Central High trapped clastics in their axes and starved the central basinal areas. During post-rift times, the block-faulted topography controlled the direction of salt migration, with salt forming linear ridges overlying footwall highs. As a result, post-rift sedimentation was concentrated in a series of linear salt-withdrawal basins, overlying syn-rift lows.

Only two seismic events are recorded in this seismogenic source zone. One is historical and the other is instrumental. The historical event has a magnitude of 4.8 occurring in June 21, 1916 whose location is in the Hadramaut arches of eastern Yemen, while the instrumental data has occurred in July 21, 1997 and located also in the vicinity of the arches. No statistical analysis is performed for this seismogenic source zone, but a brief summary of the seismotectonic correlation is presented in the accompanying graphical presentation of a logic tree diagram.


Insufficient data
Mmax(S) = ; a= ; b =
ASSR = mm/yr ; ASM0R =
Tr(Dmax) = yr ; Pr = %
Strike
Slip
Tr(M0max) = NA ; Pr = NA
P
Fault Length = km
H(Mmax) = km
Fault Source
ZONE 20 H
Southern Yemen
Area Source
Mmax(A) =
Abrupt
Dislocation =
P
H(Mmax) =

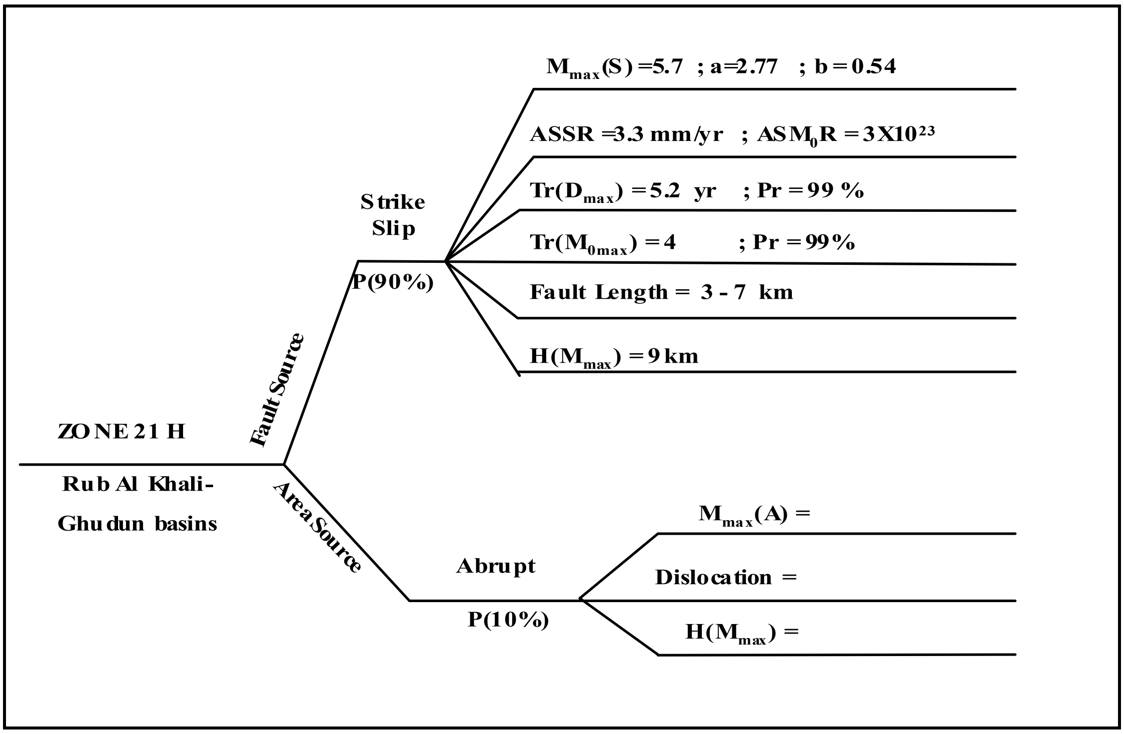

Insufficient data
Mmax(S) = ; a= ; b =
ASSR = mm/yr ; ASM0R =
Tr(Dmax) = yr ; Pr = %
Strike
Slip
Tr(M0max) = NA ; Pr = NA
P
Fault Length = km
H(Mmax) = km
Fault Source
ZONE 20 I
Southern Yemen
Area Source
Mmax(A) =
Abrupt
Dislocation =
P
H(Mmax) =

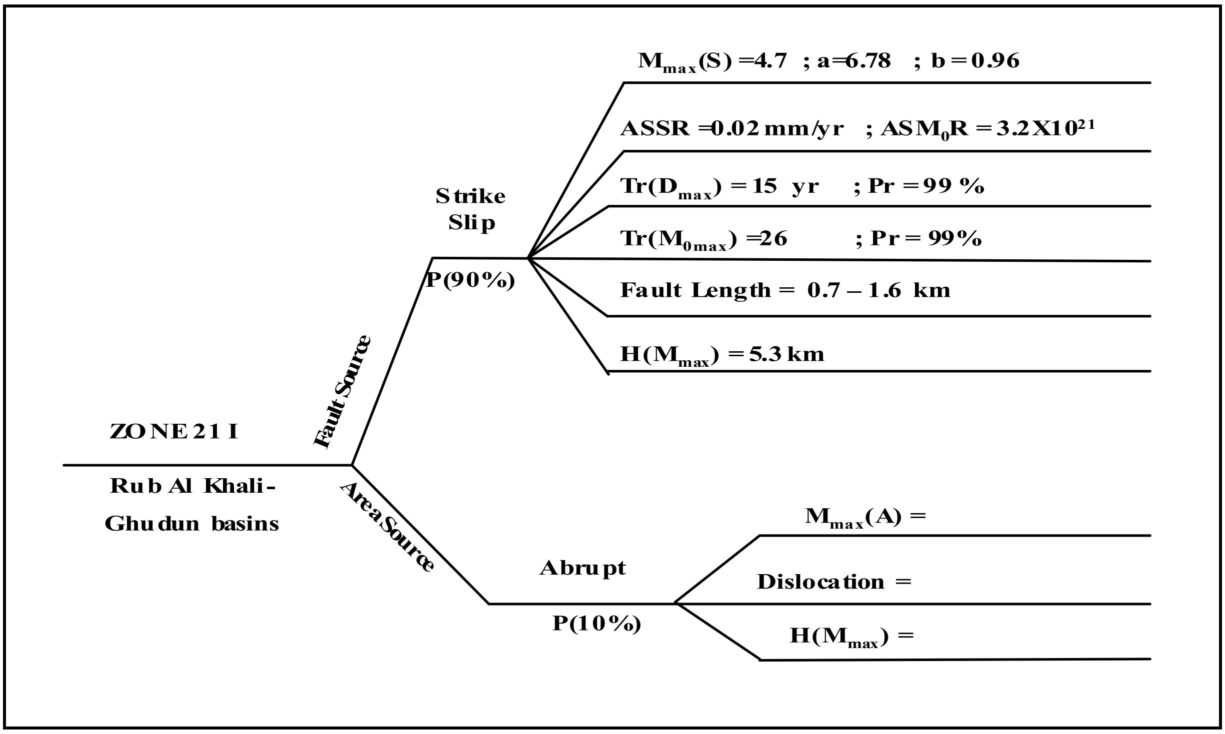
Zone 21 (Rub Al Khali-Ghudun Basins)

The most important tectonic elements in Oman are the three known Infracambrian salt basins. These are the Fahud and Ghaba salt basins in the north and the south Oman salt basin. Immediately to the west of the south Oman basin is the Ghudun-Khasfah high. It shows a north trending positive linear gravity anomaly that separates the south Oman basin from a gravity low to the west. It is thought that the western gravity low in the extreme southwest represents a fourth Infracambrian basin. This new basin is called Ghudun salt basin and appears to be comparable in areal extent with the Ghaba basin and analogous with the other Oman salt basins. The depth of the basement is estimated to be from 8-10 km.

The tectonic history of the Ghaba salt basin is dominated by compressional events ranging in age from late Precambrian to Tertiary. The Ghaba salt basin is described as a push-down basin. The loading of the Oman mountains led to the development of foreland basins. Loading from the north resulted in a regional dip in that direction on which the Mesozoic carbonate section began to slide, resulting in a series of extensional faults of WNW oreintation. This event allowed reactivation of the salt and many diapirs developed.

There are only 8 documented seismic events in this seismogenic source zone. Two were historical and 6 are instrumental. The maximum magnitude observed for the historical is 5.6 in Aug 20, 1954 which is located the Rub Al khali basin. The observed maximum magnitude for the instrumental data is 5 in Aug 20, 1997 which is also located in the basin. Due to seismic data constraint, statistical analysis is conducted mainly with the instrumental period of observation using Utsu-Aki (1965) maximum likelihood estimate of the values of the seismicity parameters. These are: a = 6.78; b = -0.96; Mmax = 4.7. A brief summary of the seismotectonic correlation is graphically presented by the accompanying logic tree diagram.


M$_{max}$(S) =5.7 ; a=2.77 ; b = 0.54
ASSR =3.3 mm/yr ; ASM$_0$R = 3X10^{23}
Tr(D$_{max}$) = 5.2 yr ; Pr = 99 %
Tr(M$_{0max}$) = 4 ; Pr = 99%
Fault Length = 3 - 7 km
H(M$_{max}$) = 9 km
Strike Slip
P(90%)
Fault Source
ZONE 21 H
Rub Al Khali-
Ghudun basins
Area Source
Abrupt
P(10%)
M$_{max}$(A) =
Dislocation =
H(M$_{max}$) =


M$_{max}$(S) =4.7 ; a=6.78 ; b = 0.96
ASSR =0.02 mm/yr ; ASM$_0$R = 3.2X10^{21}
Tr(D$_{max}$) = 15 yr ; Pr = 99 %
Tr(M$_{0max}$) =26 ; Pr = 99%
Fault Length = 0.7 – 1.6 km
H(M$_{max}$) = 5.3 km
Strike Slip
P(90%)
Fault Source
ZONE 21 I
Rub Al Khali-
Ghudun basins
Area Source
Abrupt
P(10%)
M$_{max}$(A) =
Dislocation =
H(M$_{max}$) =

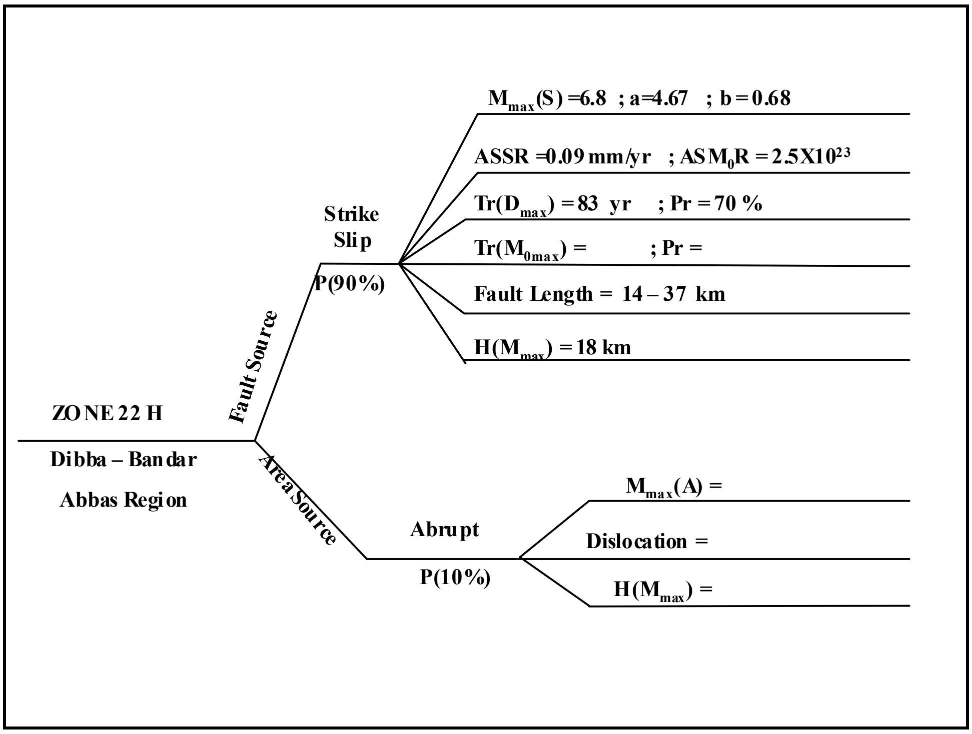
Zone 22 (Dibba-Bandar Abas Region)

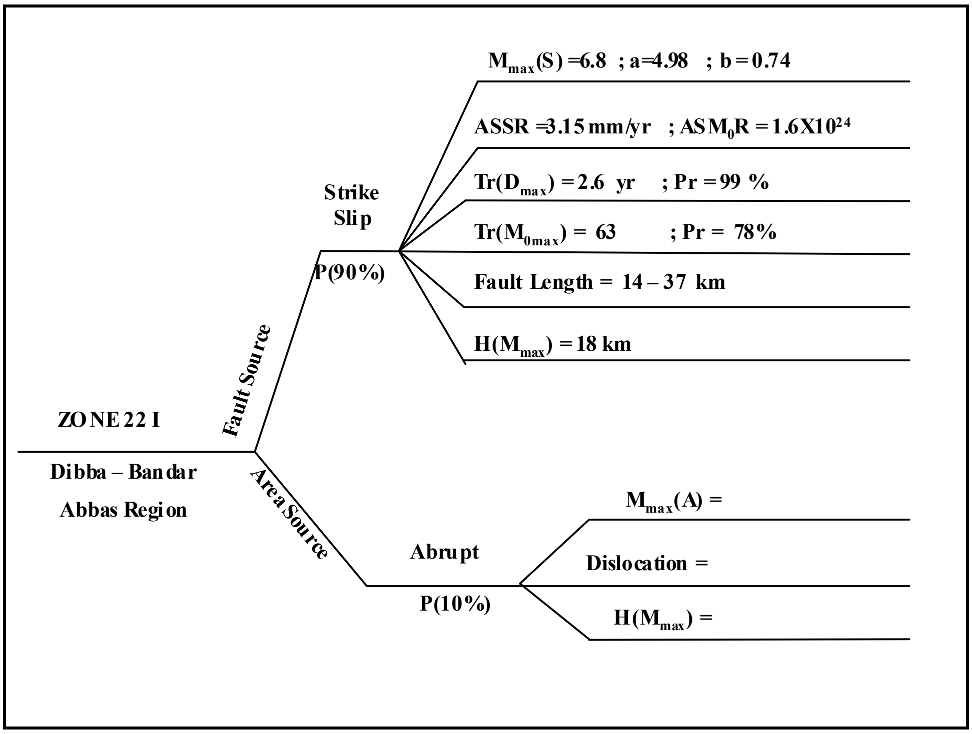
The primary tectonic units in this source zone are the Dibba fault and the Hormuz salt basin south of the Arabian gulf. The Dibba line in Oman marks a probable former transform fault. To its south, Cretaceous subduction began in Neo-Tethys 2, with back arc spreading leading to the development of what became the Semail Ophiolite nappe. Because of the very narrow microcontinent Jbel Qamar-Kawr ridge separating the Neo-Tethys 1 and 2, there was little effective resistance to the subduction process until the Maastrichian, when inability to consume the Oman sector of the Arabian continental process to a halt. With compressive stresses absorbed in Paleo-Tethys, late Cretaceous obduction in Neo-Tethys 1 and 2 did not lead to creation of the Oman and Zagros mountains.

In central Arabia, there was a slow but progressive infill of the intrashelf basins through repetitive shoaling upward carbonate cycles in the late Jurassic. At the beginning of the Cretaceous, global sea level was high and consequently most of the Arabian plate accumulated almost exclusively shallow marine carbonates. The Arabian basin was rapidly infilled, first by carbonates and later bu terrigenous clastics. In the late early Cretaceous, extensive rudist banks colonized the shelf breaks to the intrashelf basins such as in the southern gulf. Far field stresses have thought to have resulted in the uplift and erosion of the western part of the Arabian shield and the supply eastward of large amounts of terrigenous clastics and shallow marine sands. The plate stress, combined with sufficient sediment loading served to trigger the growth of salt structures in the area of the southern Arabian gulf over which numerous rudist banks developed. At the southern portion of the Arabian gulf is where the Hormuz salt basin lies. The Hormuz is interpreted as a syn-rift sequence. This interpretation implies that the Hormuz evaporate basins were intra-continental (Ziegler 2001).

Two lines of spatial distribution of epicenters can be distinguishingly seen in this seismogenic source zone. The first which is a thin line of distribution is along the Dibba fault in northern

Oman. The second has a wider zone of epicenter distribution. It is the convergence zone between southwestern Iran and northwestern Oman, a line known as Oman line that passes west of the Lut block in Iran. This seismic source area is both historically and instrumentally active. Two earthquakes of magnitude 6.4 occurring in Jan 10, 1897 and the other in July 9, 1902 were located in the convergence zone. Likewise, two earthquakes of magnitude 6.2 have also occurred in March 21, 1977 and Apr 1, 1977 in almost the same location. It is noted that this seismogenic source zone seems to have frequent earthquakes of above magnitude 6 and many seismic events above magnitude 5. Statistical analysis of the historical and instrumental data using the cumulative frequency-magnitude relation gives for the historical seismicity parameters the values for a = 4.67; b = 0.68; Mmax = 6.8; and for the instrumental data are: a = 4.98; b = 0.74; Mmax = 6.8. A brief summary of the seismotectonic correlation for this source zone is graphically presented with the accompanying cumulative frequency-magnitude relation and logic tree diagram.





Zone 23 (Hawasina-Makran Thrust Region)

During the rift cycle one (Vendian/Infracambrian period), a series N-S to NE-SW trending basement high in Oman may have developed. These are the Ghudun-Khasfah high, the Anzaus-Rudhwan ridge, and the Makarem-Mabrouk high separating different basin segments. The event is associated with igneous activity (Oman mountains) and is followed by a thermal subsidence phase. Around 110 Ma, the Atlantic ocean begins to open, leading to the closure of the Neo-Tethys between the Afro-Arabian and Eurasian plates. A northeasterly dipping intra-oceanic subduction zone develops, accompanied by arc-spreading. At 93 Ma, this subduction complex collided with the continental crust of Oman creating the Zagros-Makran subduction zone . The initial uplift has been described as a mobile or stationary fore-bulge that preceded downwarping of the foreland ahead of the advancing thrust front. The second rift cycle which is also a compressional event as in rift cycle one occurred in the late Eocene to Miocene time.

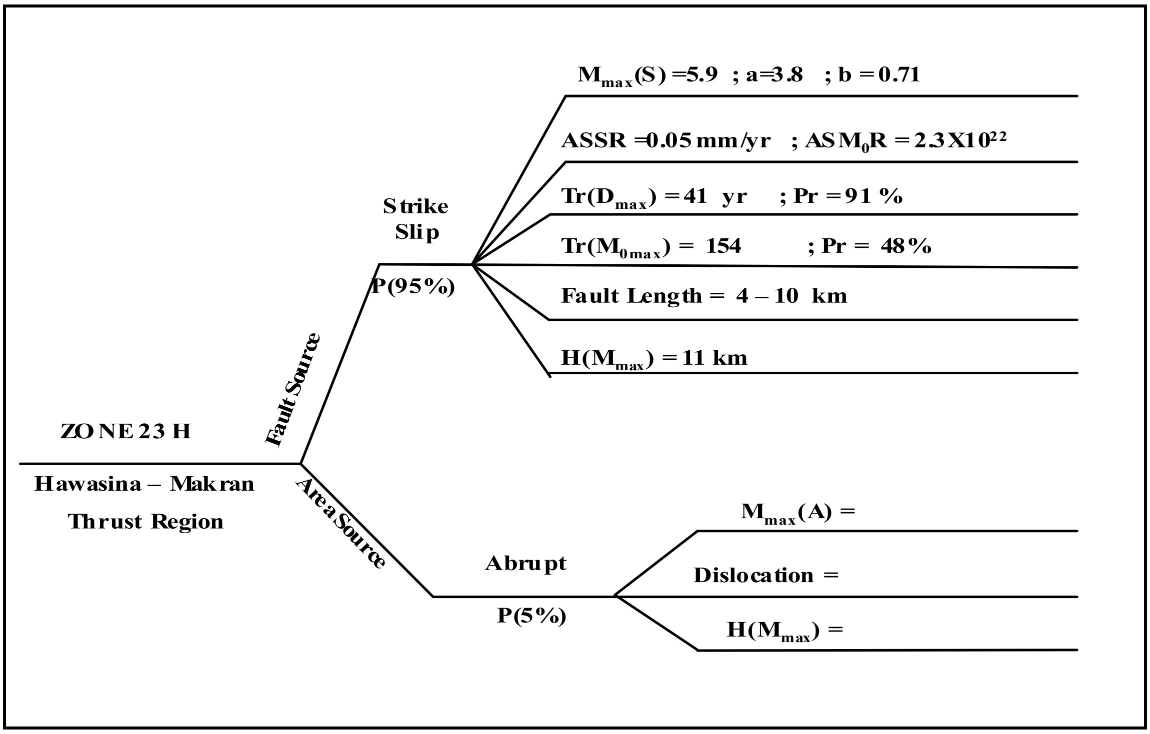
This event was responsible for the folding and short distance thrusting of the of the allochthonous units of the upper Cretaceous and Tertiary neo-authochthonous cover cover in the foredeep basins. The Huwayyah anticline is a unique example. The Tertiary compressional event caused reactivation of the late Cretaceous basal ramp fault to form the Huwayyah anticline and associated thrust strike-slip faults. The second event can be correlated with the Zagros oregeny in Iran. Two angle reverse faults are found in the western flank of the Huwayyah anticline. These are oriented in a NNW and ENE directions parallel and perpendicular to the fold of the anticline respectively. The main reverse fault is named Auha. A second reverse fault lies east of Auha. These faults probably originated as ordinary west dipping thrust on the western flank of the anticline. The displacement of the strike-slip faults are in the order of a few several meters and the sense of displacement suggests dextral movement.

The northern flank of the Sohar basin is limited by the Makran accretionary prism. This is an elongated and structurally complex thrust belt resulting from the subductionof oceanic basement under the Eurasian plate. The Makran is actively today and advancing southward at a maximum rate of some 10 cm/yr. Large overthrust anticline are recognized along the frontal thrust belt. Towards the core of the accretionary prism fault density increases creating a highly complex and deformed thrust belt.

Spatial distribution of earthquake epicenters in this zone is sparse. Some are found to be located in the Zagros-Makran subduction zone, in the gulf of Oman, the Hawasina thrust sheets, and in the Maradi fault zone. One earthquake event for each in the Hawasina and Maradi fault is located. Historical seismicity indicates that the observed maximum magnitude is 5.5 in May 13, 1905 which is located in the gulf of Oman. The instrumentally observed maximum event has a magnitude of 4.8 in June 15, 1977 and likewise is located in the gulf area.

Seismicity analysis for the historical and instrumental data using the Utsu-Aki maximum likelihood estimate method gives the following values for the historical seismicity parameters: a = 3.8; b = -0.71; Mmax = 5.9, and for the instrumental data: a = 3.47; b = --0.76; Mmax = 4.8.

A brief summary for the seismotectonic correlation is presented with the accompanying graphical logic tree diagram.



Zone 24 (East Sheba Ridge)

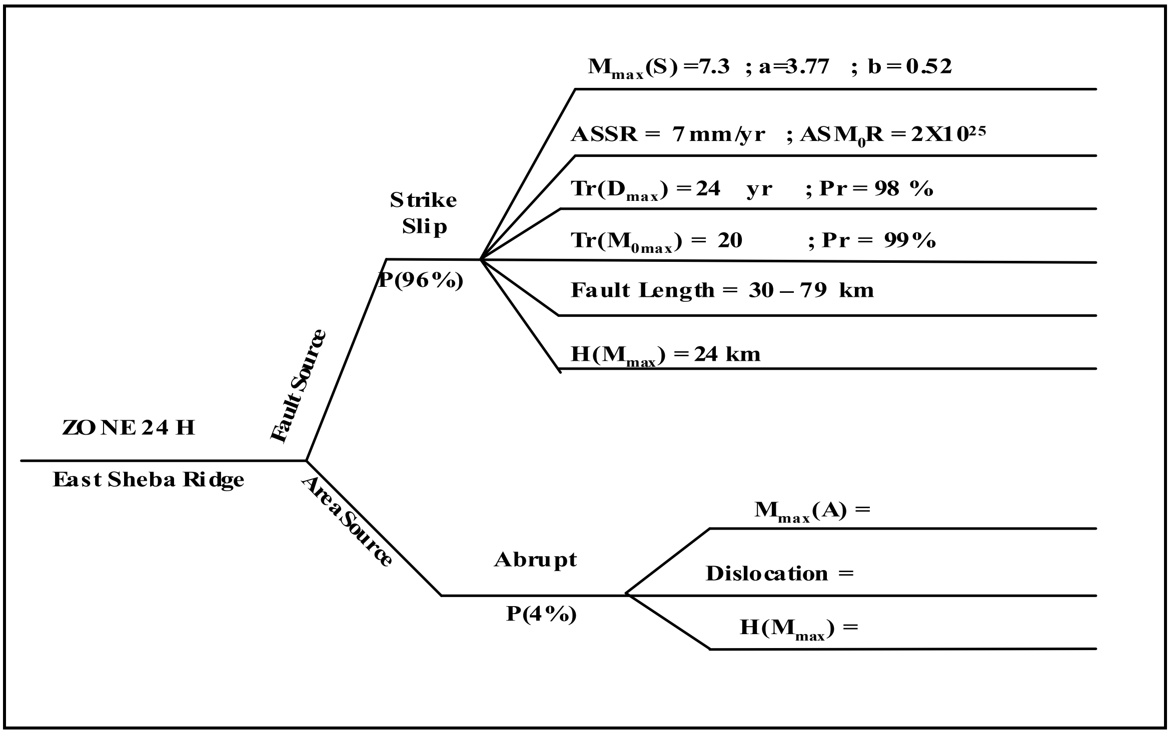
In the late Campanian-early Mastrichian, a rift developed between Seychelles and India. This rifting culminated in the Deccan volcanic event at approximately 64 Ma, when a new oceanic spreading zone which is the Carlsberg ridge developed. Above the Carlsberg ridge to the northeast is another ridge which is called the East Sheba ridge that connects the main trough of the gulf of Aden. The Sheba ridge is bounded by the Alula-Fartak trench to the west and by the Owen fracture zone to the east.

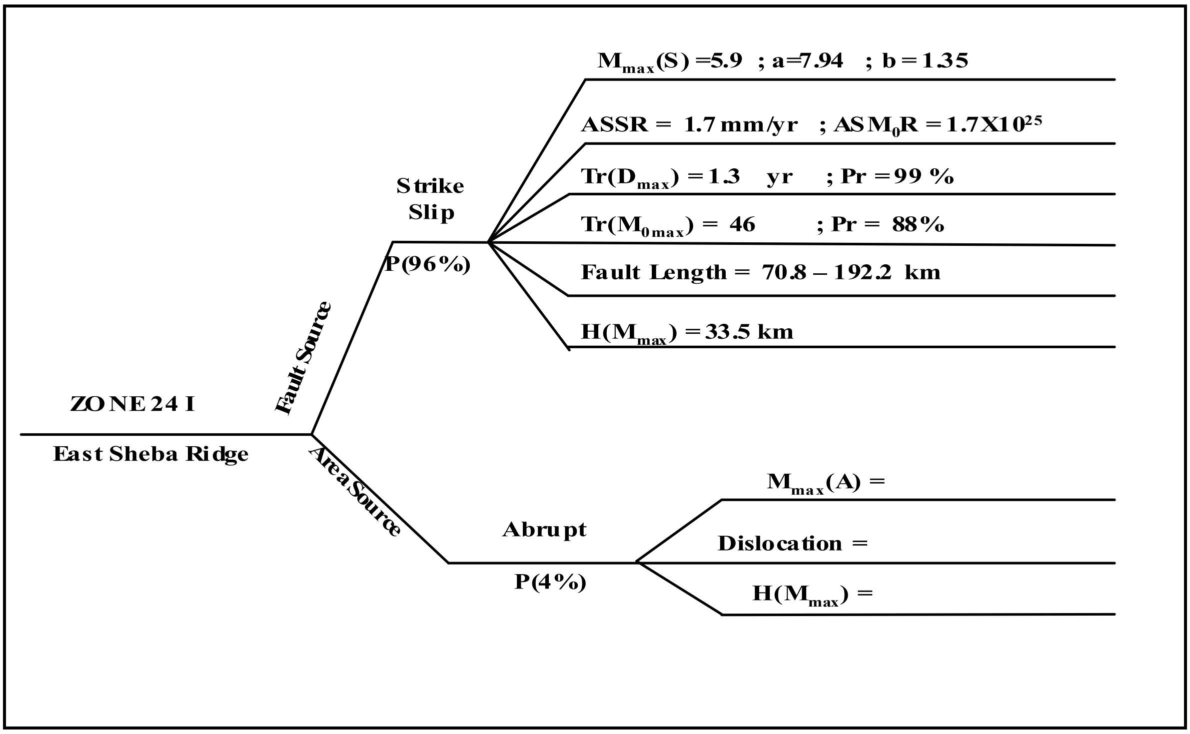
Epicenters distribution in this zone shows good correlation between seismicity and topography. The main line of epicenters follows the crest of the Carlsberg ridge that turns at 10.5N, 57.0E to a NNE direction, continuing in this orientation up to 13N. At this latitude, it turns abruptly in a northwestward direction. The line of epicenters lies closely along the axis of the Sheba ridge to about 56.5E where the seismic events are clustered.

This zone is active historically up to the present time. The observed maximum earthquake in the histrorical time has a magnitude of 6.6 in Aug 17, 1899. This event is located off the main ridge axis. The instrumental maximum magnitude is 5.6 in Dec 5, 1981. Its location is likewise in the vicinity of the main ridge.

Statistical analysis conducted on the historical and instrumental data using the cumulative frequency-magnitude relation gives for the values of the historical seismicity parameters as follow: a = 3.77; b= -0.52; Mmax = 7.3; while for the instrumental data analysis are obtained the values for a = 7.94; b = -1.35; Mmax = 5.9.

A brief summary of the seismotectonic activity for this zone is accompanied by its graphical presentation of the cumulative frequency-magnitude relation and the logic tree diagram.


M_{max}(S) =7.3 ; a=3.77 ; b = 0.52
ASSR = 7 mm/yr ; ASM_0R = 2X10^{25}
Tr(D_{max}) = 24 yr ; Pr = 98 %
Tr(M_{0max}) = 20 ; Pr = 99%
Fault Length = 30 – 79 km
H(M_{max}) = 24 km
Strike
Slip
P(96%)
Fault Source
ZONE 24 H
East Sheba Ridge
Area Source
Abrupt
P(4%)
M_{max}(A) =
Dislocation =
H(M_{max}) =


M_{max}(S) =5.9 ; a=7.94 ; b = 1.35
ASSR = 1.7 mm/yr ; ASM_0R = 1.7X10^{25}
Tr(D_{max}) = 1.3 yr ; Pr = 99 %
Tr(M_{0max}) = 46 ; Pr = 88%
Fault Length = 70.8 – 192.2 km
H(M_{max}) = 33.5 km
Strike
Slip
P(96%)
Fault Source
ZONE 24 I
East Sheba Ridge
Area Source
Abrupt
P(4%)
M_{max}(A) =
Dislocation =
H(M_{max}) =

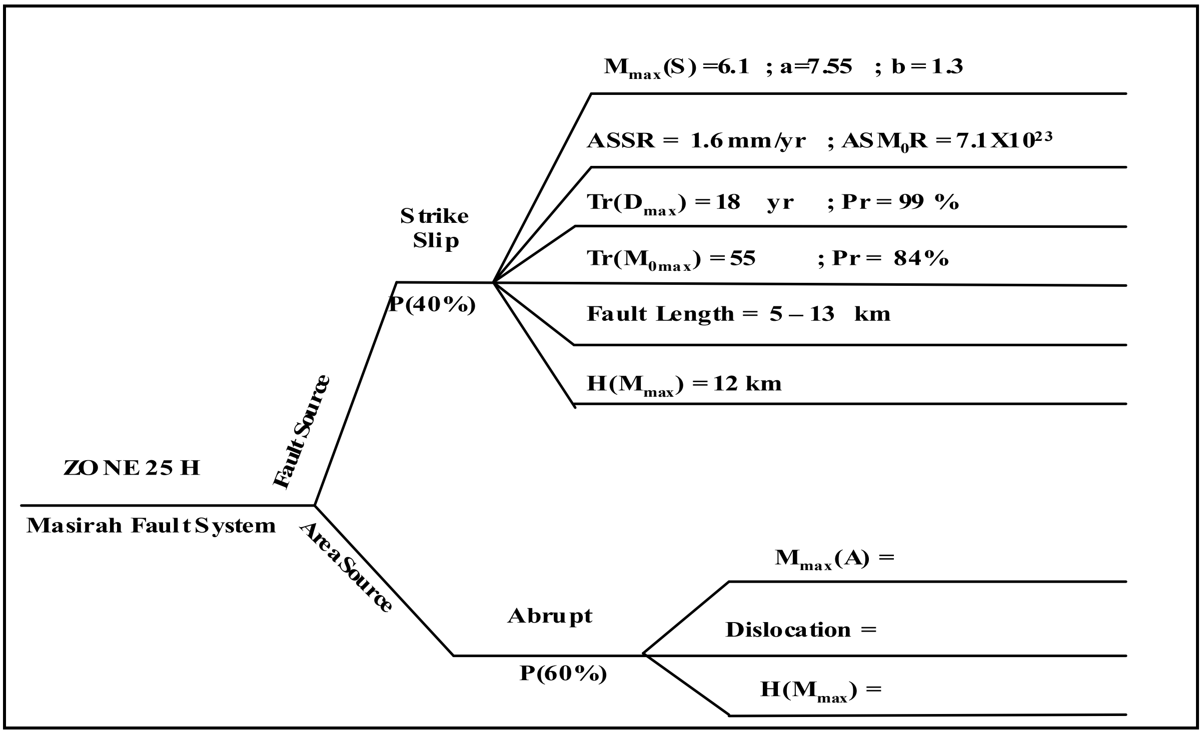
Zone 25 (Masirah Fault System)

At the Cretaceous/Tertiary boundary, intra-oceanic north over south thrusting between the lower and upper ophiolitic nappes of Masirah island occurred. Along the east coast of Oman, largely offshore under Masirah bay and Sawqrah bay, a narrow gently folded foreland basin which is the Masirah trough was developed. The western margin is bounded by normal faults reactivating Mesozoic rift related faults. On its eastern margin, a wedge of ophiolitic and probably continental slope sediments is largely underthrusted below the eastern and uplifted part of the foredeep basin. To the south of the trough lies the Masirah transform fault.

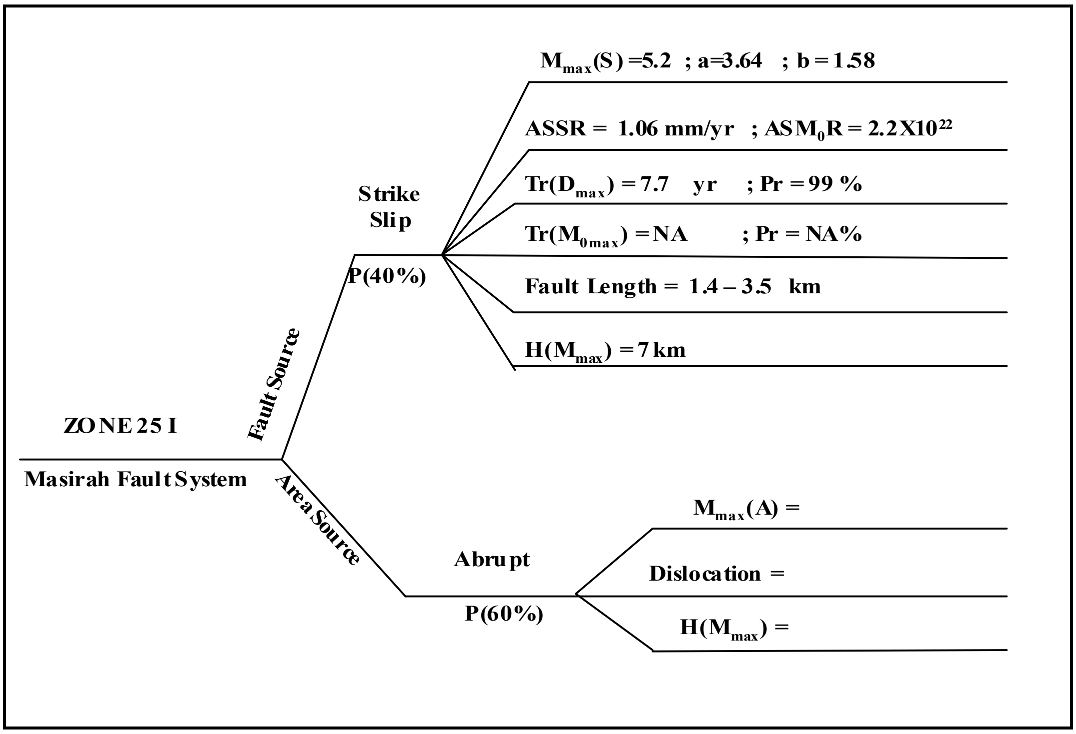
The number of seismic events compiled for the historical and instrumental data are 7 and 4 respectively for this zone. The maximum historical event has a magnitude of 6.5 in Oct 10, 1900. Its epicenter is at 16N, 60E which is in the Owen fracture zone. For the instrumental data, the maximum magnitude is 5.2 in Mar 15, 1983. This event is also placed in the Owen transform fault. Only one event of magnitude 5.1 is found to occur in the Masirah thrust zone, while others can be considered as area source earthquakes or could be due to the influence of the Masirah and Owen transform faults.

Seismic parameters for this zone have been determined using the Utsu-Aki (1965) maximum likelihood estimate method for the historical and instrumental data. The values of the parameters are as follow: a = 7.55; b = -1.3; Mmax = 6.1 for the historical, and a = 3.64; b = -1.58; Mmax = 5.2 for the instrumental.

A brief summary of the seismotectonic activity for this zone is accompanied by the graphical presentation of the logic tree diagram.



ZONE 25 H
Masirah Fault System
Fault Source
Area Source
Strike Slip
P(40%)
M$_{max}$(S) =6.1 ; a=7.55 ; b = 1.3
ASSR = 1.6 mm/yr ; ASM$_0$R = 7.1X10^{23}
Tr(D$_{max}$) = 18 yr ; Pr = 99 %
Tr(M$_{0max}$) = 55 ; Pr = 84%
Fault Length = 5 – 13 km
H(M$_{max}$) = 12 km
Abrupt
P(60%)
M$_{max}$(A) =
Dislocation =
H(M$_{max}$) =


M_{max}(S) =5.2 ; a=3.64 ; b = 1.58
ASSR = 1.06 mm/yr ; ASM_0R = 2.2X10^{22}
Tr(D_{max}) = 7.7 yr ; Pr = 99 %
Tr(M_{0max}) = NA ; Pr = NA%
Fault Length = 1.4 – 3.5 km
H(M_{max}) = 7 km
Strike Slip
P(40%)
Fault Source
ZONE 25 I
Masirah Fault System
Area Source
Abrupt
P(60%)
M_{max}(A) =
Dislocation =
H(M_{max}) =

SEISMIC ZONATION

Seismic zonation is the division of geographic region into smaller areas or zones expected to experience the same relative severity of an earthquake hazard (e.g., ground shaking, ground failure, surface faulting, tsunami wave runup, etc.,). The resulting zonation maps provide community policymakers and development.

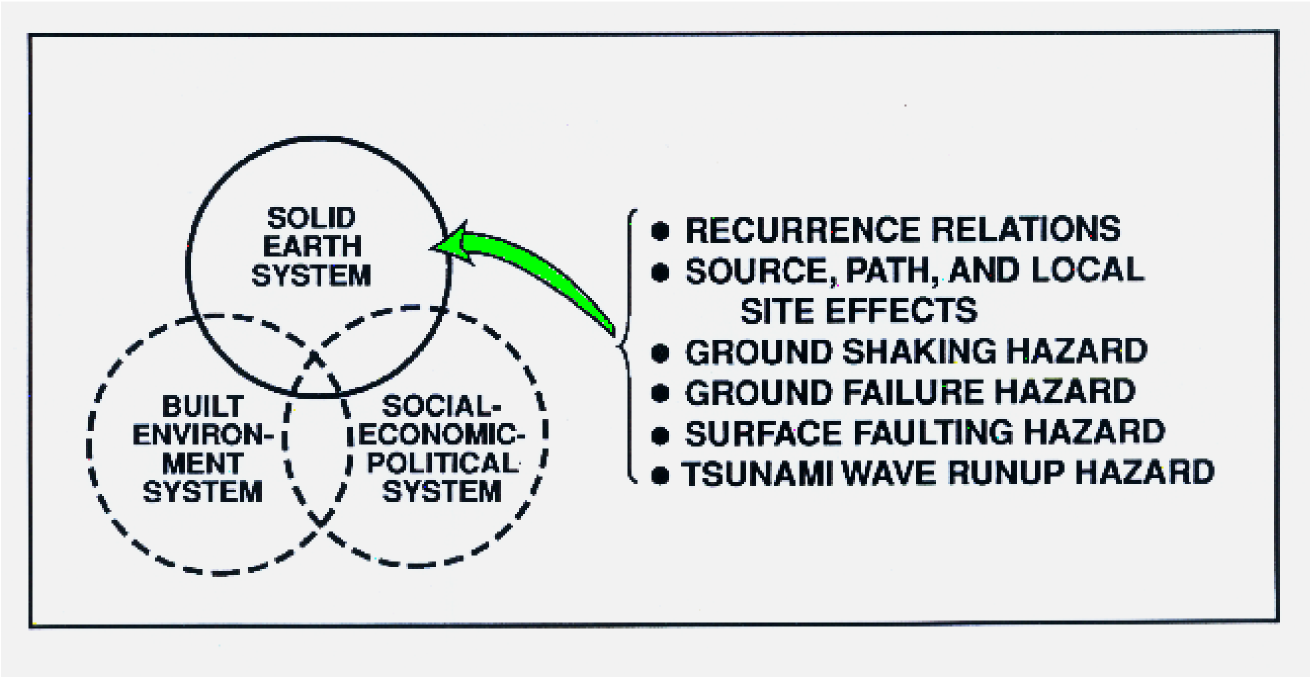
The key questions are summarized below:

1. **Solid Earth System** (i.e., defines the physical characteristics of the source, path, and site which control earthquake hazards (e.g., ground shaking and ground failure hazards)).
   - Where have earthquakes occurred in the past?
   - Where are they occurring now?
   - What is the magnitude and depth distribution of the past and present seismicity?
   - How often have earthquakes of a given magnitude recurred?
   - What are the dominant earthquake generating mechanisms?
   - What levels of ground shaking have occurred in the past? Ground failure? Surface fault rupture? Tsunami wave runup?
   - What are the maximum levels that might be expected in future earthquakes?

2. **Built Environment System**, (I,e., defines the temporal and spatial distribution of buildings and lifeline systems exposed to earthquake hazards).
   - What are the physical characteristics of the present inventory of buildings and lifeline systems (e.g., age, type of materials, number of stories, elevation, plan, foundations, etc.)? The future inventory?
   - How have these buildings and lifeline systems performed in past earthquakes (e.g., what are the vulnerability relations for each type of building and lifeline?

3. **Social-Economic-Political System**, (I,e., defines the community's earthquake risk management policies and practices (e.g., mitigation, preparedness, emergency response, and recovery).

- ❖ What risk management policies and practices (i.e., building and land use regulations) have been adopted by the community in the past?
- ❖ How have they been enforced?
- ❖ How effective have they been?



REDUCTION OF COMMUNITY VULNERABILITY

BUILT ENVIRONMENT

- Location value, exposure, and vulnerability of buildings and lifelines at risk earthquake physical effects (hazards) which can cause damage, failure, lo function, release of hazardous materials, injuries, and deaths.

HAZARD ENVIRONMENT	POLICY ENVIRONMENT
* Physical effects such as: Ground shaking; liquefaction; landslides; surface fault rupture; tectonic deformation; fires, and flood waves from seiche, tsunami, and dam break generated in an earthquke and the aftershock sequence; each potentially impacting the built environment.	*Social, technical, Aadministrative, political, legal, and economic forces which shape a community's policies and practices for: earthquake risk management (i.e., prevention, itigation, preparedness, prediction and warning, intervention, emergency), public awareness, training, education, and insurance.

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Earthquake Glossary

Acceleration – a force with the units of gravity that denotes the rate of change in time of the movement of the ground during an earthquake.

Accelerogram – refers to a seismic record from an accelerometer, a device in recording the time history of ground acceleration at a site. Peak acceleration is the largest value of acceleration on the record and typically used in design criteria. Ground velocity and displacement time histories can be derived analytically from an accelerogram.

Acceptable risk – probability of occurrence of physical, social, or economic consequences of an earthquake that is considered by authorities to be sufficiently low compared to significant effects.

Aftershocks. Earthquakes that follow the largest shock of an earthquake sequence. They are smaller than the mainshock and within 1-2 fault lengths distance from the mainshock fault. Aftershocks can continue over a period of weeks, months, or years. In general, the larger the mainshock, the larger and more numerous the aftershocks, and the longer they will continue.

Amplification. Most earthquakes are relatively small, in fact, so small that no one feels them. In order for seismologists to see the recording of the movement of the ground from the smaller earthquakes, the recording has to be made larger. It's like looking at the recording through a magnifying glass, and the amount that it is magnified is the amplification. Shaking levels at a site may also be increased by focusing of seismic energy caused by the geometry of the sediment velocity structure, such as basin subsurface topography, or by surface topography.

Attenuation. When you throw a pebble in a pond, it makes waves on the surface that move out from the place where the pebble entered the water. The waves are largest where they are formed and gradually get smaller as they move away. This decrease in size, or amplitude, of the waves is called attenuation.

Artificial – type of an earthquake that is produced when explosive devices are detonated.

Attenuation – a decrease in the strength of seismic waves and seismic energy with distance from the source.

Azimuth – angle made by the longitude of the epicenter and the line joining the epicenter and recording station measured in a clockwise manner.

Built Environment – defines the temporal and spatial distribution of buildings and lifeline system exposed to hazards.

Body-wave Magnitude – when the magnitude value is determined from the body-waves.

Creep. Slow, more or less continuous movement occurring on faults due to ongoing tectonic deformation. Faults that are creeping do not tend to have large earthquakes.

Depth of focus – vertical distance between focus and epicenter.

Disaster – occurrence of a hazardous event which adversely affects a community to such a degree that essential social service and functions of physical structures are disrupted.

Displacement. The difference between the initial position of a reference point and any later position. The amount any point affected by an earthquake has moved from where it was before the earthquake.

Duration – length of time between the onset and departure of a natural hazard.

Duration Magnitude – when the magnitude value is evaluated from seismic trace duration of a recorded earthquake event.

Earthquake - transient vibrations of the earth's crust due to the release of the stored strain energy in a focal volume. The energy is transmitted in all directions by means of the generated seismic waves. There are three classifications of earthquakes. These are classified as tectonic, volcanic, and artificial.

Earthquake Hazards – the primary and secondary physical effects generated by an earthquake such as ground shaking, differential ground movements, landslides, tsunami, and etc).

Elements at Risk – the people, ecosystem, environment, natural structures and man-made buildings that are exposed to natural and technological hazard.

Epicenter – is the location of an earthquake on the surface of the earth. It is directly above the focus. It is represented as a point that is defined by its geographical coordinates.

Epicentral Distance – distance between epicenter and a seismic recording station.

Exceedance probability – probability that an earthquake will generate a level of ground motion that exceeds a specified reference level during a given exposure time.

Exposure Time – the period of time that a structure or community is exposed to potential earthquake and other natural hazards.

Fault – a fracture or a zone of fractures in the earth which displacement of the two sides relative to one another has occurred as a consequence of compression, tension, or shearing stress. A blind fault is the term used to describe a fault system that is not visible at the surface of the ground. An active fault is one that exhibits physical characteristics such as historic earthquake activity, surface fault rupture, geologically recent displacement of stratigraphy or topography, or physical association with another fault system judged to be active.

Foreshocks. Foreshocks are relatively smaller earthquakes that precede the largest earthquake in a series, which is termed the mainshock. Not all mainshocks have foreshocks.

Ground Failure – term referring to the permanent, inelastic deformation of the ground triggered by ground shaking.

Ground Shaking – refers to the dynamic , elastic, vibratory movement of the ground in response to the arrival of the different seismic waves.
Hazard – potential threat to humans and their welfare. The threat could be due to natural and technological origin.

Hazard Assessment – an estimate of the range of the threat such as the magnitude, frequency of occurrence, and duration of the natural and technological hazard to humans and their welfare.

Hazard Environment – defines the physical characteristics of the source, path, and site effects.

Hypocenter/Focus – a point in the earth where the earthquake originates. The hypocenter is a simple representation of the focal volume of an earthquake where strain energy is stored. The focal point can be assumed to be where the first break of rupture happens when an earthquake occurs.

Hypocentral Distance – distance between focus and a seismic recording station.

i or e – prefix to the international symbols used in the identification of the different seismic phases. i and e means an impulsive/sharp and emergent/gradual beginning of the initial onset of a recorded seismic phase on a seismogram respectively.

Intensity – a measure of the local ground motion effects on man and its environment, to all types of building structures, and on free nature. There are different intensity scales used in the seismological community. The scales are named after their respective founders or country of origin. Intensity scales are composed of grades/degrees expressed in the Roman numerals. Each grade described the limitation/extent of the observable effects to man and its environment, to building structures, and to free nature.

Landslide – refers to the falls, topples, flows of rocks from unstable slopes.

Local Magnitude – when based from Richter magnitude scale.

Love (LQ) – a wave that moves on a horizontal plane perpendicular to the direction of motion. It is prominently recorded in the horizontal components of a LP seismograph.
Liquefaction – refers to loss of soil bearing strength that occurs mainly in young, shallow, loosely compacted, water saturated sand and gravel deposits when subjected to ground shaking.

Magnitude. A number that characterizes the relative size of an earthquake. Magnitude is based on measurement of the maximum motion recorded by a seismograph. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as "Richter magnitude," (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw). Scales 1-3 have limited range and applicability and do not satisfactorily measure the size of the largest earthquakes. The moment magnitude (Mw) scale, based on the concept of seismic moment, is uniformly applicable to all sizes of earthquakes but is more difficult to compute than the other types. All magnitude scales should yield approximately the same value for any given earthquake.

Mainshock. The largest earthquake in a sequence, sometimes preceded by one or more foreshocks, and almost always followed by many aftershocks.

Microzonation. The identification of separate individual areas having different potentials for hazardous earthquake effects.

Mitigation – range of policies, legislative acts, professional practices, and social adjustments that are designed to minimize the effects of earthquakes and other natural hazards on a community.

Moment Magnitude – measure of the size of an earthquake referred from the moment of the equivalent body force and the over-all source spectrum of an earthquake.

Natural Hazard – potential threat to humans and their welfare caused by slow and rapid onset events having natural origin (atmospheric, geologic, and hydrologic) on a global, regional, and local scales (typhoons and storms, earthquakes and volcanic eruptions, floods, and tsunami run up).

Origin Time – time of occurrence of an earthquake. It is expressed in hours, minutes, and seconds in the universal coordinated time (UTC) or Greenwich meridian time (GMT).

Percent "g". G or g is the force of gravity. When there is an earthquake, the forces caused by the shaking can be measured as a percentage of the force of gravity, or percent g.

Poisson distribution. A probability distribution that characterizes discrete events occurring independently of one another in time.

Preparedness – refers to using mitigation processes on a community to plan for emergency response, recovery, and rehabilitation after a disastrous earthquake.

Primary Wave – is the first wave to arrive at a recording seismic station. It is a longitudinal type of wave that moves in a push and pull manner along the direction of motion. There are different types of p-wave in accordance to the mode of travel. These are the Pg, P*/Pb, Pn, and P.

Pg – a direct longitudinal wave in near epicentral distance.

P*/Pb – a guided longitudinal head wave that travels along the Conrad discontinuity.

Pn – a guided longitudinal head wave that travels along the Mohorovicic discontinuity.

Policy Environment – defines the community's hazards risk management policies and practices.

Recurrence interval. The average time span between large earthquakes at a particular site. Also termed return period.

Rayleigh (LR) – a wave that moves in an elliptical manner along the direction of motion. It is prominently recorded in the vertical component (Z) of a long period (LP) seismograph.

Response Spectrum – a graph of the output of a mathematical model which shows how an idealized ensemble of lightly damped, simple harmonic vibrating building responds to a particular ground motion. The source of ground motion is an accelerogram that is used to excite the model in the period range 0.05-10 seconds, a period range of interest to engineers. The concept of response spectrum is used in building codes and design of essential and critical structures.

Risk – probability of loss to the elements at risk from the occurrence of natural and technological hazard.

Risk Assessment – an objective scientific assessment of the chance of loss or adverse consequences when physical and social elements are exposed to potentially harmful natural and technological hazards. Risk assessment integrates hazard assessment with the vulnerability of the exposed elements at risk.

Risk Management – public process of implementing decisions that involves choices and actions designed to minimize potential losses when risk assessment indicates the risk.

S*/Sb – a guided transversal head wave that travels along the Conrad discontinuity.

Secondary Wave – the second wave to arrive at a recording seismic station. It is a transversal type of wave that moves in an up and down manner perpendicular to the direction of motion. It is also known as a shear wave. There are different types of secondary wave in accordance to their mode of travel. These are the Sg, S*/Sb, Sn, and S.

Seismic gap. A section of a fault that has produced earthquakes in the past but is now quiet. For some seismic gaps, no earthquakes have been observed historically, but it is believed that the fault segment is capable of producing earthquakes on some other basis, such as plate-motion information or strain measurements.

Seismic Station – a place or site where a seismograph is installed and operated, and maintained.

Seismic Waves – are motions of disturbance when an earthquake occurs. There are two kinds of seismic waves. These are the body and surface waves. The body wave moves through the body of the earth. The surface wave moves through the surface of discontinuities in layered media. The body wave is composed of two types. These are the primary (p) and secondary (s) waves. The surface wave/long wave (L) is also composed of two types that were named after their discoverer. These are the Rayleigh (LR) and the Love (LQ) waves.

Seismic Zonation – the division of a geographic region into smaller areas or zones based on an integrated assessment of the hazard, built and policy environments of a region. Zonation maps are the results of a process that integrates data, results of research, built and policy environments. The maps contribute to risk reduction and sustainability of the growth and the new developments.

Seismogenic Structure – a geologic structure such as an igneous pluton dike, or sill that has earthquake activity associated with it.

Seismogram – a seismic record from a seismograph.

Seismograph – an instrument that records the relative motion of the ground.

Sg – a direct transversal wave in near epicentral distanceSSS.

Sn – a guided transversal head wave that travels along the Mohorovicic discontinuity.

Shear stress. The stress component parallel to a given surface, such as a fault plane, that results from forces applied parallel to the surface or from reinote forces transmitted through the surrounding rock. If you lean against the edge of the door where the latch is, you are applying shear stress to the door.

Soil Amplification – a period-dependent property of the soil to ground motion. It is a function of the relative density of the soil to the base rock.

Soil/Structure Resonance – a physical phenomenon that increases the potential for destructiveness when the input seismic waves caused the soil and structure to vibrate at the same period.

Source Directivity – a physical phenomenon that increases ground shaking at a site due to the directional aspect of the fault rupture that cause most of the energy to be released in a particular direction instead of in all direction.

Spectral acceleration or SA. PGA (peak acceleration) is what is experienced by a particle on the ground. SA is approximately what is experienced by a building, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building.

Strong motion. Ground motion of sufficient amplitude and duration to be potentially damaging to a building or other structure.

Surface-wave Magnitude – when the magnitude value is computed from the surface waves.

Surface Fault Rupture – a physical phenomenon of the rupturing fault breaking the surface of the ground and releases more energy on the side of the fault that is moving, thereby increasing ground shaking at the moving part than at the stationary block.

Tectonic – type of an earthquake that is generated when relative motion occurs among large deformed body of rocks.

Technological Hazard – potential threat to humans and their welfare caused by technological factors (chemical release, nuclear accidents, dam failure).

Volcanic – type of an earthquake that is generated due to magmatic movements in a volcano.

Vulnerability – potential loss in value of each element at risk from the occurrence and consequences of natural and technological hazards. The factors that influence vulnerability include demography, built and policy environments, social differentiation and diversity, and political and economical strategies. Vulnerability is a result of flaws in planning, siting, design, and construction.

APPENDIX

HISTORICAL AND INSTRUMENTAL SEISMICITY DATA (112 – 2003 A.D) FOR THE ARABIAN PENINSULA AND ADJOINING REGION. THESE DATA ARE USED TO DEFINE AND DELINEATE THE TWENTY FIVE (25) SEISMIC SOURCE ZONES.

<u>**Seismogenic Source Zones Of Arabian Peninsula**</u>

Zone No.	**Name**	**Cooridinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
1	**Gulf of Suez**	**30.28**	**31.23**	**32058**
		31.27	**32.22**	
		27.14	**33.87**	
		27.81	**34.70**	

<u>**Historical Events (Zone 1)**</u>

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1307	8	10	0	0	0	30	31.2	4.5
1313	2	27	12	0	0	30	31.2	4.5
1335	5	29	17	0	0	30	31.2	4.6
1347	12	8				30	31.2	4.6
1385	9	19	0	0	0	30	31.2	4.6
1386	7	17	10	0	0	30	31.2	4.5
1422	6	28				30	31.2	4.5
1425	6	23	0	0	0	29	33	5
1425	6	23	6	0	0	29	33	5.8
1433	12	14	18	0	0	30	31.2	4.5
1434	1	6	11	45		30	31.2	5.8
1455	3	5				30	31.2	4.6
1467	12	15	18	0		30	31.2	4.5
1476	10		18	0		30	31.2	4.5
1483	6	15	18	0		30	31.2	4.5
1486	10	11	12	0		30	31.2	4.5
1498	9					30	31.2	4.5
1513	3	28	6	0		30	31.2	4.6
1523	4	4	22	0		30	31.2	4.5
1525	3	9	18	0		30	31.2	4.5
1527	7	14	5	0		30	31.2	4.5
1529	11	12	4	0		30	31.2	4.4

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1532	7	10	0	0		30	31.2	4.4
1534	3	23	6	0		30	31.2	4.4
1576	4	1	18	0		30	31.2	4.6
1588	4	7	6	0		29.4	31.6	4.7
1710	8	27	8	0		29	33	5.4
1754	10	0	0	0	0	29.6	32.2	6.6
1801	10	10	21	0		30	31.2	4.6
1814	6	27	0	0	0	29	33	5.5
1825	6	21	21	0		30	31.2	4.6
1846	6	15				30	31.2	4.6
1849	7	23	3	0		30	31.2	4.5
1858	12					30	31.2	4.5
1879	7	11	0	0	0	29	33	5.8
1886	11	17	16	30		30	31.2	4.5
1895	12	7	2	40		30.6	31.2	4.9
1900	1	18	5	29	0	29	33	4.1
1900	3	6	17	58	0	29	33	6.2
1903	5	6	0	0	0	30.1	31.2	5.5
1906	12	26	13	43		27.2	33.4	4.9
1909	2	26	20	57		27.6	33.6	4.8
1910	1	6	19	20		29.9	33.8	5.5
1911	1	5	1	59	6	30	31.3	5
1911	1	26	17	35	36	28	33.7	4.3
1911	8	22	20	23		28.8	32.6	4.3
1911	11	12	19	30		28.2	33.6	5
1917	2	22	10	22	10	28.2	33.6	5
1922	6	18	19	38	57	28.8	32	4.2
1922	7	29	20	48	20	30.3	31.2	4
1922	9	7	1	7	46	28	34	4.2
1925	5	20	23	27	33	30	32	4.4
1935	6	14	19	2	14	29.9	31.3	4.1
1938	11	6	15	36	18	30.2	31.8	4
1947	7	3	3	30	28	28.9	33.1	4.2
1947	12	10	19	18	1	27.5	34	4.2
1949	5	22	13	1	50	29.9	31.3	4.5
1949	11	5	23	47	14	27.4	34	4.2
1949	12	1	10	31	58	29	33	4
1952	2	25	22	48	5	29.6	32.3	4

Instrumental Events (Zone 1)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1969	3	24	12	50	50.5	27.57	33.79	4.8
1969	3	24	11	54	15.5	27.53	33.83	5.2
1969	3	27	6	15	30	27.49	33.75	4.7
1969	3	31	11	30	5	27.46	34.03	4.6
1969	3	31	22	40	48.5	27.67	33.99	4.7
1969	3	31	9	1	12.7	27.43	34.07	4.9
1969	3	31	21	44	32.5	27.59	34.15	5
1969	3	31	7	15	54.4	28.4	34.38	6.1
1969	4	3	20	6	13.5	27.44	33.97	4.5
1969	4	4	12	18	48	27.65	33.83	4.7
1969	4	5	17	51	11.8	27.53	33.99	4.5
1969	4	8	10	31	52.2	27.5	33.72	5.2
1969	4	13	16	15	15	27.81	33.79	4.8
1969	4	14	13	43	54.8	27.08	33.28	4.9
1969	4	16	8	12	54.6	27.59	33.97	5
1969	4	17	8	1	4.1	27.63	34.01	4.8
1969	4	23	13	37	21	27.59	33.94	5
1969	5	10	9	27	57	27.5	34.18	4.8
1969	5	25	11	32	38.6	27.62	33.98	4.8
1969	8	3	23	51	10.2	27.55	33.91	4.5
1969	8	9	13	28	31.9	27.67	33.75	4.7
1969	12	30	5	10	3.3	27.5	33.88	4.9
1970	1	9	6	16	14	30.2	34	4.7
1970	4	28	3	20	34.7	27.67	33.63	4.9
1970	12	19	12	15	34.1	27.51	33.88	4.6
1970	12	19	22	44	9.3	27.55	33.86	4.6
1971	6	20	10	22	0	28.75	32.57	4
1971	7	8	23	40	56.3	27.54	33.82	4.8
1971	7	9	14	48	0	27.45	33.45	4.8
1972	1	12	8	15	46.1	27.53	33.75	5.1
1972	6	28	9	49	34.9	27.65	33.76	5.6
1973	3	5	23	59	46.6	27.69	33.64	4.5
1974	3	26	20	42	0	28.16	33.45	4.2
1974	4	5	23	14	0	27.91	33.2	4
1974	4	29	20	4	37	30.53	31.72	5.4
1982	10	30	4	36	46	27.76	34	4.5
1983	6	12	12	0	6.34	28.51	33.11	5
1984	3	29	21	36	10.8	30.18	32.38	4.7

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1984	4	6	18	30	56.1	30.38	33.91	4.6
1984	4	18	20	20	24	28.72	33.22	4
1984	12	8	7	41	53.48	27.65	34.01	4.5
1985	2	28	16	55	47.22	27.96	33.82	4.6
1986	4	8	8	43	34.61	27.21	34.29	4.3
1987	1	2	10	14	47.5	30.33	32.3	5
1988	6	5	18	26	57.84	27.97	33.78	4.8
1988	11	29	17	6	57.2	28.27	33.54	4
1989	9	6	21	27	27.11	27.66	33.86	4
1989	12	18	21	48	15.3	28.58	33.22	4.6
1990	1	24	3	57	51.52	27.6	34.23	4.1
1990	2	23	4	58	14.7	27.04	32.73	4
1990	12	4	9	15	35	28.3	32.84	4.2
1991	3	27	0	18	25.3	27.62	33.72	4
1991	9	6	0	38	37.9	27.68	33.9	4.2
1991	10	5	18	48	26.1	29.5	32.63	4.3
1991	11	26	10	41	46.4	28.88	33.25	4
1991	12	5	0	52	44.4	28.55	32.71	4.5
1992	5	22	23	10	43.79	30.16	32.04	4.5
1992	8	2	3	30	46	27.52	34.02	4
1992	9	25	22	2	58.5	27.54	34.1	4.1
1992	9	25	22	2	54.62	27.39	34.08	4.1
1992	9	25	22	20	19.6	27.32	34.03	4.2
1992	9	25	21	35	39.67	27.92	33.98	4.2
1992	9	26	1	9	57.23	28.29	33.8	4
1992	10	14	3	50	15.61	30.09	31.28	4.1
1992	10	20	1	58	0.1	28.49	33.12	4.1
1992	10	22	17	39	0.6	29.76	31.54	4.5
1992	10	27	11	2	44.1	28.64	32.85	4.2
1992	10	27	9	44	49.5	28.88	33.04	4.3
1992	10	29	3	25	12	27.38	34.35	4
1993	3	29	3	38	6.5	28.99	33.06	4.1
1993	4	2	22	3	42.4	27.83	33.74	4.1
1993	7	19	8	53	52.2	27.53	34.38	4.3
1993	8	3	15	42	54.66	28.89	33.71	4.4
1993	10	29	18	8	38	30.39	32.07	4
1994	1	2	7	49	51	28.75	33.31	4.1
1994	2	10	18	54	21	28.07	32.98	4
1994	9	26	17	27	2.4	27.22	33.84	4.2
1994	9	28	9	38	39	29.48	32.59	4.1
1995	3	15	9	20	31.12	27.62	33.93	4.5
1995	5	14	7	2	54	27.8	34.33	4.3
1995	5	14	4	0	5.8	27.58	34.34	4.8
1995	9	8	12	13	26	29.73	32.34	4.4

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1995	11	28	3	33	38	27.89	34.9	4.3
1996	4	24	21	58	21	27.07	33.79	4.1
1996	4	25	21	58	50	27.04	34.91	4.2
1996	8	21	20	6	36	29.57	32.23	4.1
1996	11	11	8	26	38	30.3	32.23	4.1
1996	11	26	9	29	32	30.25	32.23	4.3
1996	11	26	9	29	32.66	30.43	32.19	4.6
1996	12	1	13	44	35	30.35	32.27	4.3
1996	12	20	7	21	31.67	28.52	33.6	4.4
1996	12	23	8	53	12.47	27.52	33.88	4.5
1997	3	8	15	21	2.31	27.54	34.19	4.8
1997	3	10	23	0	33	30.57	32.14	4
1998	4	10	10	35	50	27.67	34.08	4.4
1998	6	6	2	54	40	29.55	32.78	4
2000	3	8	14	22	17.53	29.16	34.03	4.9
2000	6	25	19	18	40.6	28.6	31.86	4.3
2000	6	29	14	44	48	29.2	32.9	4
2000	10	8	3	5	9.445	28.73	34.37	4.1
2001	1	5	19	3	56.4	28.5	33.5	4
2001	1	7	1	21	22.5	28	34	2.8
2001	1	9	12	51	18.1	27.6	33.4	3
2001	1	18	2	42	35	27.6	34.3	3.6
2001	1	26	4	26	32	30.6	31.9	3.4
2001	2	3	0	28	6.91	27.68	34.1	3
2001	2	13	19	24	45.63	27.75	34.35	2.98
2001	2	17	23	37	33.18	27.51	34.18	2.86
2001	3	3	21	3	12.91	28.13	34.1	2.98
2001	3	5	22	58	30.85	27.57	33.84	3.3
2001	3	7	11	13	51.28	27.61	33.98	3.3
2001	4	2	11	29	35.8	30.9	31.7	3.3
2001	4	2	17	15	2.5	27.7	34.3	2.6
2001	4	8	9	48	7.15	27.6	34.3	2.6
2001	4	18	4	14	19.3	27.9	33.1	3.1
2001	8	13	14	32	38.12	27.84	33.87	2.52
2001	8	13	22	6	30.7	27.18	33.65	3.71
2001	8	13	22	31	43.6	28.13	33.15	3.19
2001	8	13	22	2	26.92	27.63	33.97	3.2
2001	8	15	5	16	28.75	27.9	33.4	3.06
2001	8	17	6	36	34.09	27.6	34.04	3.14
2001	8	18	7	7	55.2	27.23	34.48	3.38
2001	8	18	23	15	22.38	27.56	33.96	3.07
2001	8	19	8	56	37.48	29.61	33.56	2.62
2001	8	19	12	36	23.72	28.3	32.86	2.98

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	8	19	15	10	38.3	27.74	33.42	2.98
2001	8	19	16	0	21.37	28.72	32.93	3.62
2001	8	19	16	9	44.5	28.09	33.24	3.12
2001	8	20	2	57	14.37	28.11	33.38	3.76
2001	8	20	15	55	6.92	28	33.09	3.31
2001	8	20	16	31	55.5	27.8	34.1	4.47
2001	8	20	18	4	55	27.38	33.77	4.33
2001	8	20	17	43	21.45	27.59	33.77	3.51
2001	8	24	15	55	50.5	27.92	33.2	3.57
2001	8	26	15	47	3.99	28.35	33.71	2.75
2001	8	28	8	1	11	27.84	34.26	4.4
2001	9	12	5	3	5.94	27.83	33.72	2.97
2001	11	2	15	0	45.232	28.47	33.22	2.7
2001	11	6	12	19	43.182	28.1	33.7	3
2001	11	7	4	5	7.06	27.91	34.39	3.8
2001	11	7	4	43	12.084	27.93	34.31	2.8
2001	12	7	5	27	58.85	28.65	33.9	2.63
2001	12	14	15	32	8.04	28.64	33.15	3.1
2001	12	19	7	19	20.34	28.49	33.5	3.6
2001	12	30	7	48	49.86	29.65	32.17	3.3
2002	2	13	18	52	9.67	28.03	33.66	3.91
2002	2	18	16	27	21.75	27.72	34.07	3.98
2002	2	25	7	26	40.85	28.7	33.79	4.14
2002	3	11	1	15	58.67	28.72	33.75	4.16
2002	3	14	4	48	53.471	27.94	34.23	3.66
2002	3	20	13	27	29.406	28.07	34.29	3.42
2002	3	20	13	58	32.67	28.09	34.19	3
2002	3	22	12	31	47.838	27.83	34.48	3.06
2002	7	17	20	56	19.52	27.48	34.37	3.3
2002	7	17	21	24	18	27.55	34.51	2.9
2002	8	1	3	26	37.01	27.33	34.32	2.67
2002	8	1	4	6	41.42	27.41	34.2	3.21
2002	8	1	4	19	5.58	27.65	34.22	3.06
2002	8	8	4	4	30.25	27.58	34.53	3.75
2002	9	22	11	56	14.866	27.8	33.93	3.06
2002	10	4	16	24	10.2	28.9	35.5	3
2002	10	19	23	32	14.8	27.6	34.4	2.8
2002	10	25	18	4	43.8	28	33.6	3.6
2002	12	9	6	53	51.91	28.13	33.83	2.8
2002	12	9	7	2	5.93	28.1	33.89	2.6
2002	12	14	12	30	8.58	27.94	34.21	2.7
2003	12	10	21	22	13.49	27.87	33.99	3.8

Zone No.	Name	Cooridinates		Area (KM^2)
		Lat. N	Long. E	
2	**Gulf of Aqaba-Dead Sea**	**32.31**	**35.22**	**43050**
		32.28	**36.48**	
		28.33	**33.30**	
		27.81	**34.73**	
		28.81	**34.02**	

Historical Events (Zone 2)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
112	0	0	0	0	0	31	35	6.2
551	7	9	0	0	0	32	36	5
747	1	18	0	0	0	31.8	35.7	4.5
1047	0	0	0	0	0	31.92	34.85	5
1091	2	12	0	0	0	28.5	34	5.7
1212	5	2	0	0	0	30	35.2	6.7
1292	0	0	0	0	0	31.92	34.85	5
1293	1	0	0	0	0	31	35.6	6.6
1312	5	1	0	0	0	28.5	34	5
1458	11	16	0	0	0	31	35	6.5
1546	1	14	16	0		32	35.1	6
1575	0	0	0	0	0	31	35	5
1801	0	0	0	0	0	28.5	34	5
1839	0	0	0	0	0	28.5	34	5.6
1924	9	13				30.8	35.5	4.8
1927	7	11	13	3		32	35.5	6
1927	7	17	8	15		32	35.5	4
1928	1	18				32	35.5	4
1928	2	3	0	0	0	32	35.76	4
1928	2	22	17	50	55	32	35.5	5
1928	11	4				32	35.5	4.2
1929	3	24	12	11		32	35.5	4
1930	5	21	10	45		32	35.5	4.5
1930	5	30	6	58	52	29.4	34.7	4.2
1934	5	12	16	46	21	29.1	34.9	4.2
1937	10	12				31.5	35.5	5.5
1940	9	2	10	32	0	32	35.5	4.5

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1954	9	13	21	46	0	30.8	35.5	4.8
1956	12	18	17	53	0	30.5	35.5	5.5
1958	4	13	12	2	3	29	34.8	4
1961	6	26	1	34	0	31	35.5	4

Instrumental Events (Zone 2)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1968	12	4	23	42	0	31.8	35.61	4.2
1969	1	2	9	10	0	30.49	35	4
1969	1	2	16	21	0	30.5	35	4
1969	3	24	11	54	15.5	27.53	33.83	5.2
1969	3	27	6	15	29.9	27.53	33.94	4.7
1969	3	31	21	44	32.5	27.59	34.15	4.6
1969	3	31	22	40	48.5	27.67	33.99	6
1969	3	31	7	15	54.4	28.4	34.38	6.1
1969	4	4	12	18	48	27.65	33.83	4.6
1969	4	4	6	42	57	27.68	34.07	4.7
1969	4	5	17	51	11.8	27.53	33.99	4.5
1969	4	13	16	15	11.3	27.62	33.84	4.8
1969	4	16	8	12	54.6	27.59	33.97	5
1969	4	17	8	1	6	27.55	33.87	4.7
1969	4	17	8	1	4.1	27.63	34.01	4.8
1969	4	23	13	37	21	27.59	33.94	5
1969	5	10	9	27	57	27.5	34.18	4.8
1969	5	25	11	32	38.6	27.62	33.98	4.8
1969	5	25	11	32	38.9	27.63	33.93	4.8
1969	8	3	23	51	10.2	27.55	33.91	4.5
1969	8	9	13	28	31	27.5	34	4.5
1969	9	26	2	14	0	27.56	33.8	5.2
1969	12	30	5	10	3.3	27.5	33.88	4.9
1970	1	9	6	16	14	30.2	34	4.7
1970	10	8	2	45	0	31.39	35.51	5
1970	12	19	12	15	34.1	27.51	33.88	4.6
1970	12	19	22	44	11.8	27.55	33.86	4.5
1971	7	8	23	40	56.3	27.54	33.82	4.8
1971	7	8	23	40	0	27.63	33.81	4.8
1972	1	12	8	15	44.1	27.55	33.82	5.1
1972	6	28	9	49	35.4	27.7	33.8	5.5
1972	6	28	8	15	48.4	27.82	33.92	4.2

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1974	9	6	5	17	0	29.91	35.71	4.3
1976	10	11	23	31	21	29.99	35	4.4
1979	4	23	13	1	0	31.24	35.46	5.1
1979	4	23	13	1	0	31.24	35.46	5
1982	10	30	4	36	46	27.76	34	4.5
1983	1	21	13	17	32.9	29.23	34.78	4.2
1983	1	25	15	59	43.2	29.03	34.58	4.2
1983	1	31	17	36	16	29.03	34.66	4.6
1983	1	31	3	55	12.4	29.14	34.67	4
1983	1	31	13	51	41.4	29.19	34.69	4.2
1983	1	31	14	56	39.1	29.28	35.01	4.7
1983	1	31	17	6	10.4	29.31	34.85	4
1983	1	31	15	18	23.3	29.49	34.54	4.7
1983	2	1	18	37	18.4	29.24	34.76	4
1983	2	2	18	16	58.1	29.09	35.03	4
1983	2	3	13	45	59.8	28.99	34.68	4.9
1983	2	3	23	30	24.6	29.2	34.81	5.3
1983	2	3	23	38	29.1	29.21	34.77	4.9
1983	2	3	17	32	26.3	29.21	35.05	4.7
1983	2	3	19	11	36.3	29.28	34.64	4.7
1983	2	4	5	47	43.7	29.19	35.02	4.6
1983	2	4	4	12	47.9	29.3	34.73	4
1983	2	5	7	35	32.3	28.99	34.99	4
1983	2	5	6	50	12.3	29.1	34.82	4
1983	2	6	17	27	21.5	29.13	34.52	4
1983	2	7	16	12	59.1	29.04	34.75	4
1983	2	8	16	55	30.9	29.1	34.74	4.4
1983	2	9	15	40	22.5	29.08	34.89	4
1983	2	9	14	44	22.8	29.12	34.66	4.2
1983	2	10	8	42	52.7	28.92	34.92	4.2
1983	2	10	17	29	21.7	28.94	34.87	4.9
1983	2	10	19	43	28.6	29.32	34.73	4.2
1984	4	6	18	30	56.1	30.38	33.91	4.6
1984	12	8	7	41	53.48	27.65	34.01	4.5
1985	1	25	6	8	3.8	31.89	35.8	4.6
1985	2	28	16	55	47.22	27.96	33.82	4.6
1985	12	31	19	42	38.4	28.95	35.05	5.3
1986	8	7	19	46	53.1	29.18	34.91	4.3
1987	10	1	23	42	5	28.11	35.05	4
1987	10	18	15	3	35.6	28.94	34.79	4.5
1989	9	9	5	16	50.1	28.57	34.82	4.1
1990	3	15	11	24	30.1	28	34.58	4
1990	4	20	14	51	31.8	28.95	34.79	4.2

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1990	10	2	21	2	17	29.04	34.72	4.3
1990	10	2	3	21	18	30.37	34.39	6.2
1991	5	15	16	4	12.3	28.83	34.73	4.1
1991	5	16	17	28	48.9	28.91	34.76	4.1
1991	9	5	22	29	49.7	28.08	34.38	4.1
1991	9	6	0	38	37.9	27.68	33.9	4
1991	11	2	2	25	22.4	27.83	34.89	4
1992	2	3	21	15	16.6	27.54	34.69	4
1992	9	3	17	9	25.9	27.68	34.78	4.4
1992	9	25	22	2	58.5	27.54	34.1	4.4
1992	9	25	22	2	58.5	27.54	34.1	4.4
1992	9	26	1	9	51.3	27.5	33.93	4.5
1992	9	26	1	9	51.3	27.5	33.93	4.5
1992	10	7	21	34	50.6	27.74	34.72	4.1
1993	7	19	8	53	52.2	27.53	34.38	4.2
1993	7	19	11	57	1.3	27.99	34.52	4.1
1993	7	30	23	34	10.6	28.7	34.65	4.6
1993	7	31	17	52	39.1	27.73	34.55	4.8
1993	8	3	18	56	5.3	27.93	34.88	4.4
1993	8	3	20	4	32.2	28.09	34.87	4.3
1993	8	3	12	54	5	28.15	34.6	4.8
1993	8	3	23	56	27.7	28.19	34.89	4.4
1993	8	3	15	42	52.9	28.26	34.62	4.5
1993	8	3	12	31	18.3	28.35	34.92	4.8
1993	8	3	14	10	36	28.43	34.7	4.1
1993	8	3	23	44	42.4	28.44	34.88	4
1993	8	3	13	53	1.4	28.45	34.64	4.4
1993	8	3	12	43	8.4	28.45	34.82	5.8
1993	8	3	17	44	23.5	28.46	34.64	4.4
1993	8	3	14	6	10.5	28.48	34.58	4.3
1993	8	3	16	55	50.7	28.54	34.57	4.1
1993	8	3	17	13	33.5	28.54	34.64	4.4
1993	8	3	15	38	4.8	28.54	34.81	4.4
1993	8	3	19	34	13.4	28.55	34.77	4.2
1993	8	3	15	57	53.2	28.55	34.85	4.6
1993	8	3	17	50	21.4	28.56	34.85	4.8
1993	8	3	14	34	26.5	28.6	34.25	4.3
1993	8	3	15	47	37.7	28.63	34.62	4.1
1993	8	3	18	9	58.9	28.63	34.78	4.2
1993	8	3	16	59	28.5	28.63	35.05	4.5
1993	8	3	15	19	45.2	28.65	34.84	4.3
1993	8	3	13	33	51.6	28.69	34.71	4.2
1993	8	3	13	29	34.2	28.69	34.84	4.2

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1993	8	3	18	2	5.3	28.71	34.83	4.9
1993	8	3	13	12	23.8	28.77	34.56	4.2
1993	8	3	16	33	22.4	28.8	34.82	5.6
1993	8	3	16	44	12	28.89	34.63	4.8
1993	8	3	20	53	56.6	29.02	34.84	4.8
1993	8	4	17	7	2.8	28.15	34.25	4.1
1993	8	4	8	33	54.8	28.28	34.67	4
1993	8	4	2	43	11.1	28.54	34.61	4
1993	8	5	9	49	29.8	28.1	34.83	4
1993	8	5	17	42	22.9	28.18	34.79	4.4
1993	8	5	7	17	52.6	28.35	34.62	4.2
1993	8	5	9	52	44.5	28.5	34.62	4.1
1993	8	5	1	36	21.8	29.01	34.9	4.1
1993	8	6	13	9	49.3	28.26	34.92	4.2
1993	8	6	5	28	28.5	28.62	34.79	4.1
1993	8	6	17	48	1.1	29.01	34.87	4.4
1993	8	7	4	55	43.3	28.8	34.68	4.5
1993	8	8	13	3	16.6	28.01	34.75	4.2
1993	8	8	3	18	5.7	28.41	34.58	4.1
1993	8	9	6	5	6	28.81	34.69	4.9
1993	8	9	7	49	24.5	28.96	34.6	4
1993	8	10	6	39	58.4	28.56	34.66	4
1993	8	10	5	59	46.5	28.64	34.62	4.2
1993	8	12	7	8	4	28.48	34.62	4.2
1993	8	13	0	31	42.8	28.36	34.73	4.9
1993	8	13	15	29	33	28.65	34.9	4
1993	8	13	1	11	8	28.67	34.72	4.6
1993	8	14	15	22	47.8	28.54	34.75	4
1993	8	15	2	50	45.7	28.51	34.58	4
1993	8	15	5	11	31.9	29.03	34.67	4.5
1993	8	16	2	12	29.7	28.28	34.72	4.5
1993	8	16	11	14	37.9	28.45	34.61	4.2
1993	8	20	23	9	58.1	28.55	34.74	4.8
1993	8	21	3	2	10.6	28.72	34.61	4.1
1993	8	22	7	9	6.9	28.53	34.69	4.4
1993	9	5	13	15	19.4	28.39	34.82	4.1
1993	9	6	20	37	41.3	28.17	34.62	4.2
1993	9	6	20	50	10.8	28.18	34.57	4.4
1993	9	6	6	51	28.4	28.71	34.84	4.4
1993	9	7	1	14	29.9	28.28	34.76	4.3
1993	9	9	23	47	39.3	28.28	34.7	4
1993	9	9	23	42	45.3	28.45	34.61	4.1
1993	9	10	20	9	3.8	28.27	34.68	4.1

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1993	9	10	19	48	41	28.35	34.67	4.2
1993	9	12	23	15	45.8	28.08	34.65	4.5
1993	9	13	0	2	55.5	28.27	34.66	4.5
1993	9	20	20	17	53.1	27.9	34.88	4.6
1993	9	25	0	52	50	28.24	34.63	4.1
1993	10	3	17	48	56.9	28.31	34.92	4.3
1993	10	10	11	17	0.8	28.35	34.75	4.2
1993	10	10	11	17	5.21	28.79	34.65	4
1993	10	16	11	38	26.9	28.51	34.91	4.2
1993	10	17	20	58	10.4	28.82	34.77	4.1
1993	10	18	20	51	6.1	28.05	34.89	4.9
1993	10	18	20	51	14.14	28.85	34.58	4.6
1993	10	20	22	42	8.9	28.16	34.87	4.1
1993	10	21	0	34	56.1	28.06	34.81	4.8
1993	10	24	0	50	27.6	28.82	34.55	4
1993	11	1	7	48	32.9	27.79	34.69	4.3
1993	11	3	18	39	25	27.98	34.88	5.3
1993	11	3	19	6	55.3	28.64	34.86	4.3
1993	11	3	18	45	37.8	28.91	34.9	4.2
1993	11	7	23	10	13.9	28.26	34.81	4.2
1993	11	8	1	5	55.3	28.04	34.8	5
1993	11	8	22	56	10.42	28.62	34.51	4
1993	11	8	22	56	14.2	28.7	34.68	4
1993	11	20	11	35	58.8	28.72	34.69	4.2
1993	12	4	23	34	15.5	28.77	34.91	4.9
1993	12	21	3	13	11.2	28.86	34.55	4
1993	12	31	10	26	15.4	28.52	34.75	4.3
1994	1	2	19	16	18	28.49	34.56	4
1994	1	3	21	0	7.6	28.59	34.66	4.2
1994	1	3	18	37	45.6	28.61	34.68	4
1994	1	3	10	21	10.2	28.66	34.57	4.2
1994	1	3	10	49	49	28.66	34.71	5
1994	1	3	13	51	8.6	28.74	34.56	4.5
1994	1	4	9	30	2.6	28.63	34.69	5
1994	1	5	6	55	38	28.63	34.56	4.3
1994	1	7	16	16	2.3	28.61	34.59	4
1994	1	8	16	26	29.3	28.63	34.63	4
1994	1	12	0	33	47.4	28.78	34.71	4
1994	1	22	2	23	15.3	28.59	34.67	4
1994	1	28	20	50	16	28.56	34.67	4.1
1994	1	28	20	45	42	28.66	34.67	4
1994	1	31	21	28	8	28.37	34.88	4.5
1994	1	31	22	57	22.5	28.42	34.54	4

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1994	2	9	15	4	5.1	28.62	34.72	4
1994	2	17	23	13	37.6	28.65	34.49	4.6
1994	2	17	17	40	30	28.88	34.61	4.6
1994	3	30	15	44	20	28.64	34.59	4
1994	3	30	8	54	25	28.64	34.75	4
1994	3	31	0	58	13.2	28.65	34.69	4
1994	4	6	21	18	36	28.74	34.65	4.6
1994	4	28	8	6	55.3	28.68	35.16	4.5
1994	7	3				28.74	34.57	4.3
1994	7	5				28.69	34.61	4
1995	1	23	22	28	28	29.1	34.66	4
1995	1	24	3	35		28.67	34.67	4.2
1995	2	10	20	58	25.47	29.01	34.8	4.5
1995	2	26	8	36	33.35	27.95	34.39	4.4
1995	3	19	7	47	52.12	28.89	34.64	4.6
1995	6	4	3	52	28.13	28.52	34.66	4.2
1995	7	21	11	3	16.82	29.17	34.89	4
1995	8	3	22	53	51.28	28.7	34.71	4.9
1995	11	22	4	15	14.27	28.74	34.91	5.9
1995	11	22	12	47	7.8	28.75	34.66	5.1
1995	11	22	20	2	28.55	28.86	34.53	4.2
1995	11	22	7	17	22.74	28.89	34.31	4.2
1995	11	22	12	47	14.32	28.95	34.75	5.1
1995	11	22	12	53	22.4	28.95	34.72	4.2
1995	11	22	8	37	1	28.99	34.78	4
1995	11	22	18	7	22.3	28.99	34.77	5.1
1995	11	22	16	45	45.2	29.01	34.7	4.9
1995	11	22	18	27	48.7	29.03	34.79	4.5
1995	11	22	22	17	5.3	29.04	34.75	5
1995	11	22	7	55	31.7	29.1	34.67	4.5
1995	11	22	7	55	30.5	29.3	34.74	4.4
1995	11	23	3	5	8.7	28.86	34.53	4.5
1995	11	23	18	12	42.3	28.87	34.75	4.7
1995	11	23	18	7	16.5	28.88	34.72	5.2
1995	11	23	22	28	28	29.1	34.66	4
1995	11	24	7	28		28.66	34.67	4.1
1995	11	24	3	35		28.67	34.67	4.2
1995	11	24	9	24	51.6	28.67	34.66	4
1995	11	24	6	9		28.77	34.67	4.3
1995	11	24	16	48	31.8	28.9	34.71	4.8
1995	11	24	20	13	48	29.03	34.79	4.4
1995	11	25	14	10	48.2	28.79	34.66	4.2
1995	11	25	11	41	35.2	29.12	34.8	4.8

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1995	11	27	12	5	43.3	28.85	34.74	4.2
1995	11	27	3	5	48	28.86	34.67	4.2
1995	11	27	2	5	49	29.06	34.71	4.2
1995	11	28	12	0	54.3	29.07	34.76	4.2
1995	11	28	7	0	54.8	29.08	34.92	4.1
1995	11	29	20	40	25	29.03	34.75	4.2
1995	11	29	8	10	8.54	29.16	34.81	4
1995	11	29	9	13	49.55	29.27	34.65	4.2
1995	12	1	9	17	58	28.85	34.71	4.3
1995	12	2	21	46	53.93	29.04	34.83	4.1
1995	12	2	7	55	39	29.1	34.75	4.4
1995	12	3	21	57	52.9	28.85	34.64	4.3
1995	12	3	7	54	56	28.88	34.72	4.2
1995	12	4	20	57	46	28.64	34.56	4.3
1995	12	4	7	34	17.3	28.67	34.65	4.3
1995	12	4	2	45	27.1	28.72	34.54	4.2
1995	12	4	12	39	54.2	29.03	34.75	4
1995	12	4	17	56	44	29.04	34.71	4.3
1995	12	5	23	51	49.38	28.32	34.58	4
1995	12	5	7	23	48.56	28.99	34.51	4.1
1995	12	5	8	24	50.34	29.25	34.71	4
1995	12	5	3	38	51.16	29.27	34.65	4.3
1995	12	5	13	17	51.3	29.44	34.57	4.3
1995	12	6	11	9	59.77	28.7	34.55	4
1995	12	6	2	57	21	28.95	34.7	4.3
1995	12	6	9	47	29.4	29.09	34.84	4.7
1995	12	6	3	38	54.2	29.15	34.66	4.3
1995	12	6	14	39	1.5	29.16	34.71	4
1995	12	6	17	18	47	29.18	34.72	4.3
1995	12	6	5	18	49.21	29.28	34.66	4.2
1995	12	7	20	32	11.2	28.7	34.65	4
1995	12	7	22	28	50.62	28.82	34.63	4.1
1995	12	8	0	22	2.3	28.67	34.66	4
1995	12	8	4	12	42.6	29.03	34.75	4.9
1995	12	8	2	18	51.82	29.13	34.67	4.3
1995	12	9	6	33	49	28.75	34.62	4.2
1995	12	10	15	32	20.5	28.66	34.76	4.7
1995	12	10	13	48	1.06	29.19	34.67	4
1995	12	11	10	22	35.2	28.64	34.32	4
1995	12	11	10	54	42.65	28.64	34.64	4.5
1995	12	11	1	32	9.5	28.67	34.65	4.8
1995	12	11	0	32	9.76	28.83	34.78	5.1
1995	12	11	18	35	12.46	28.97	34.72	4.6

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1995	12	11	9	0	3.04	29.15	34.76	4
1995	12	11	0	15	7	29.16	34.76	4.1
1995	12	11	12	45	26.68	29.25	34.76	4
1995	12	11	13	9	30.66	29.34	34.71	4
1995	12	12	14	9	18.86	28.8	34.81	4.1
1995	12	13	22	48	10.72	28.72	34.59	4.5
1995	12	14	22	24	52.68	28.7	34.6	4.1
1995	12	14	3	54	0.68	28.78	35.25	4.9
1995	12	14	3	0	4.78	29.13	34.63	4.2
1995	12	14	4	51	56.75	29.14	34.75	4.2
1995	12	15	6	0	7.67	28.77	34.72	4.5
1995	12	15	3	43	32.12	28.88	34.67	4.2
1995	12	16	10	49	6.47	28.73	34.61	4.1
1995	12	16	6	20	37.84	29.15	34.59	4.5
1995	12	16	16	34	25.45	29.3	34.63	4.1
1995	12	17	10	57	24.69	28.9	34.61	4.1
1995	12	17	23	55	24.59	29.01	34.66	4.1
1995	12	17	8	47	1.27	29.09	34.65	4.3
1995	12	18	9	14	57	28.81	34.8	4.4
1995	12	18	16	57	39.99	28.96	34.75	4.3
1995	12	18	15	9	43.03	29.08	35.48	4
1995	12	19	11	49	33.15	28.56	34.73	4.1
1995	12	19	12	32	49.36	28.83	34.53	4.7
1995	12	21	7	30	1.52	28.83	34.75	4
1995	12	21	0	54	0.05	28.87	34.74	4
1995	12	21	14	6	37.84	28.94	34.55	4
1995	12	22	5	14	0.51	28.85	34.65	4.1
1995	12	22	5	14	0.51	28.85	34.65	4.1
1995	12	22	12	4	20.3	28.89	34.7	4.2
1995	12	22	5	58	43	29.15	34.72	4.2
1995	12	22	5	42	20.91	29.28	34.52	4.2
1995	12	22	5	49	27.06	29.28	34.67	4.1
1995	12	23	12	55	9.74	28.92	34.82	4.1
1995	12	23	14	53	30.09	29.15	34.79	4
1995	12	23	21	43	33.76	29.16	34.77	4.4
1995	12	23	1	43	41.22	29.18	34.68	4.1
1995	12	23	10	25	21.14	29.18	34.8	4.1
1995	12	23	6	28	50.16	29.39	34.49	4.9
1995	12	24	4	51	23.77	28.8	34.78	4.2
1995	12	24	6	56	9.99	28.8	34.69	4.1
1995	12	24	11	21	47.2	28.8	34.76	4.2
1995	12	24	23	4	56.59	29.19	34.8	4.2
1995	12	26	19	59	46.18	28.8	34.72	4.2

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1995	12	26	8	3	21.32	28.92	34.64	4.1
1995	12	26	8	3	21.32	28.92	34.64	4.1
1995	12	26	6	19	41.96	29.03	34.81	4.9
1995	12	26	0	19	12.64	29.23	34.59	4.1
1995	12	26	0	42	45.99	29.25	34.63	4
1995	12	26	6	27	13.11	29.32	34.61	4.3
1995	12	27	10	54	31	28.7	34.56	4.2
1995	12	27	13	49	26.01	28.74	34.78	4.1
1995	12	28	14	22	26.5	28.72	34.67	4
1995	12	28	19	29	22.1	28.72	34.65	4
1995	12	28	3	59	34.2	29.03	34.72	4.1
1995	12	28	0	28	11.3	29.14	34.71	4.1
1995	12	28	0	7	24.3	29.15	34.71	4.3
1995	12	29	12	4	47.98	28.84	34.67	4
1995	12	29	3	59	36.5	29.03	34.72	4
1995	12	29	0	7	22.3	29.05	34.72	4.2
1995	12	29	0	6	41.3	29.13	34.72	4.2
1995	12	29	13	32	44.8	29.21	34.73	4
1995	12	30	19	38	3.2	28.78	34.65	4
1995	12	30	5	13	39.74	28.91	34.71	4.7
1995	12	30	4	21	39.37	29.36	34.64	4.1
1996	1	2	19	14	45.49	28.84	34.65	4.5
1996	1	3	10	5	29.34	28.66	34.83	5
1996	1	3	11	4	53.4	28.7	34.74	4
1996	1	3	10	5	8	28.71	34.74	5
1996	1	4	16	25	32.9	28.62	34.75	4.3
1996	1	4	17	22	40.16	28.68	34.72	4.8
1996	1	4	17	34	48.96	28.68	34.72	4.3
1996	1	4	14	24	41.64	28.69	34.73	4.3
1996	1	4	7	31	57.3	28.88	34.76	4
1996	1	4	17	34	58	29.15	34.71	4.2
1996	1	6	7	36	7.64	28.89	34.66	4
1996	1	8	13	18	25.5	29.24	34.72	4.2
1996	1	31	9	53	34.7	28.86	34.98	4.1
1996	2	1	13	15	16.44	28.87	34.61	4.5
1996	2	2	14	42	19.55	29.13	34.77	4.5
1996	2	3	2	53	44.18	29.32	34.39	4
1996	2	9	4	29	20.62	28.63	34.03	4.1
1996	2	21	4	59	51.4	29.05	34.44	5
1996	2	21	4	59	51.47	29.05	34.44	5.3
1996	2	26	7	17	10.5	28.86	34.68	5.3
1996	2	26	16	2	2.29	28.87	34.76	4.2
1996	4	16	0	12	2.39	28.98	34.73	4.8

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1996	4	27	13	48	37.86	28.73	34.7	4.5
1996	4	27	13	48	37.86	28.73	34.7	4.5
1996	5	5	16	28	22	28.89	34.8	4
1996	6	1	16	7	1.9	28.9	34.74	4.9
1996	6	2	6	32	39.79	28.6	34.7	4
1996	6	2	21	23	15.56	28.9	34.7	4.4
1996	6	6	5	46	30.31	28.7	34.57	4.8
1996	6	8	4	14	18.43	28.7	34.31	4.5
1996	6	25	10	45	55.71	29.3	34.56	4.4
1996	9	30	6	34	40.88	28.78	34.94	4
1996	12	1	10	58	42.94	29.28	35.56	4.3
1996	12	2	19	18	4.6	29.26	34.58	4
1996	12	3	19	44	3.7	29.56	35.35	4
1997	1	5	0	8	33.73	29.04	34.33	4.1
1997	2	4	12	21	31.09	29.18	34.67	4
1997	2	20	19	30	35.31	28.78	34.85	4.1
1997	2	22	1	47	25.97	29.17	34.87	4.1
1997	2	26	0	18	38.2	28.1	34.5	4
1997	2	28	2	0	43.47	29.22	34.74	4
1997	3	8	15	52	24.74	29.22	35.08	4.4
1997	4	7	16	35	45.91	29.17	34.69	4
1997	4	14	15	3	29.63	28.93	34.79	4
1997	5	11	4	36	44.46	28.63	34.6	4.1
1997	7	7	5	15	15.24	29.37	34.75	4.2
1997	7	21	19	5	13.4	28.4	34.5	4.2
1997	7	30	9	26	59.3	29.37	34.94	4.1
1997	10	10	21	5	54.41	28.8	34.77	4
1997	12	9	16	13	9.86	28.72	34.78	4.3
1998	7	24	17	24	20.74	29.16	34.79	6
1998	10	6	6	21	31	28.72	34.8	4.5
1998	11	19	12	9	32.36	29.65	34.63	4.2
1998	11	20	8	1	27.93	27.65	33.93	4.2
1999	2	2	18	1	29.8	28.8	34.71	4
1999	6	13	4	20	11.87	28.29	34.58	4.5
1999	6	17	14	20	25.07	28.19	34.54	5
1999	6	17	14	23	4.82	28.24	34.57	5.1
1999	9	2	20	32	28.81	28.5	34.63	4.5
1999	9	2	20	32	27	28.47	34.5	4.5
1999	9	3	19	22	29.46	28.62	34.7	4
1999	10	28	15	39	17.97	30.34	34.88	4.6
1999	11	8	12	59	57.09	31.85	34.08	4.8
1999	12	18	14	50	5.34	28.71	34.85	4
1999	12	19	8	42	52.89	29.37	34.92	4.3

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2000	2	15	2	50	38.62	29.12	34.98	4.1
2000	2	15	3	0	52.03	29.26	34.63	5.1
2000	3	8	14	22	17.53	29.16	34.03	4.9
2000	7	22	10	16	35.24	29.22	35.06	4.1
2000	10	8	2	58	26.07	28.72	34.59	4.4
2000	10	8	3	5	9.445	28.73	34.37	4.06
2001	1	2	9	55	10	28.5	34.4	2.2
2001	1	2	12	18	20.78	28.8	34.8	2.4
2001	1	7	4	39	20.9	31.1	34.9	3.5
2001	1	11	7	55	11	28.9	34.8	2.6
2001	1	11	20	14	31	29.2	34.8	3.5
2001	1	11	23	43	57	28.9	34.6	2.8
2001	1	12	7	7	24	28.7	34.7	3
2001	1	13	20	47	55	28.8	34.8	3.6
2001	1	14	18	31	24	28.9	34.8	4
2001	1	14	3	0	3	28.9	34.8	2.9
2001	1	14	18	31	24	28.9	34.8	4
2001	1	16	12	13	34	30	34.8	3.6
2001	1	18	4	13	4	30.7	34.9	3.6
2001	1	19	7	51	7	28.2	34.6	3.8
2001	1	19	8	29	33	28.6	34.8	2.8
2001	1	19	12	38	15	32	36	3.3
2001	1	24	10	0	26.9	30.9	35.8	3.1
2001	1	25	11	25	24	29.2	35.7	3.5
2001	1	25	22	22	41	28.5	34.7	3.1
2001	1	27	0	46	33	29.3	34.9	3.2
2001	1	30	13	22	15	31.4	35.7	3
2001	1	31	11	54	31	31	35	3.3
2001	1	31	12	56	43	31.3	35.4	3
2001	2	5	8	35	45.45	30.97	36.07	3.2
2001	2	6	22	49	5.21	28.15	34.49	2.35
2001	2	7	3	39	3.18	29.21	34.98	4.35
2001	2	7	3	39	3.18	29.21	34.98	4.35
2001	2	8	13	29	11.79	28.79	34.74	3.38
2001	2	15	21	59	31.33	28.35	34.66	2.54
2001	2	15	12	5	55.8	31.48	36.26	2.81
2001	2	19	18	25	15.81	28.79	34.71	2.62
2001	2	21	12	12	2.66	28.74	34.63	2.72
2001	2	21	16	19	7.78	28.86	34.68	2.57
2001	2	24	18	43	17.17	28.7	34.72	2.77
2001	2	25	0	39	24.69	28.44	34.94	2.5
2001	2	25	18	19	19.35	29.25	34.76	2.86
2001	2	27	4	24	34.32	28.9	34.9	2.64

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	2	28	10	23	23.7	31.3	35.13	3.31
2001	3	4	9	35	5	28.72	34.73	2.72
2001	3	11	13	36	25.53	28.13	34.63	2.68
2001	3	15	15	3	59.83	28.58	34.76	3.77
2001	3	22	4	41	15.62	28.46	34.52	3.12
2001	3	24	0	41	18.86	29.82	34.2	2.98
2001	3	30	12	6	22.16	28.42	35.26	2.61
2001	4	3	10	12	32.6	29	35.8	2.5
2001	4	15	10	30	59	31.3	35.9	2.9
2001	4	17	11	59	7.19	29.4	35.8	2.7
2001	4	20	8	10	7.6	28.5	34.5	2.8
2001	4	20	8	23	52.9	28.5	34.5	2.8
2001	4	25	17	17	12.8	30.7	35.8	2.7
2001	4	27	0	52	49.2	28.7	34.3	3.1
2001	5	2	10	1	19.7	28.1	34.9	3.4
2001	5	4	5	28	27.99	29.1	34.9	3
2001	5	10	3	19	34.1	28.67	34.82	3.8
2001	5	10	3	52	51.72	28.76	34.75	2.8
2001	5	10	4	45	15	28.74	34.73	2.7
2001	5	10	7	6	48.94	28.74	34.81	2.7
2001	5	10	16	53	56.33	28.71	34.83	3
2001	5	11	3	26	54.22	28.43	35.03	3.8
2001	6	1	16	48	50.22	30.61	35.75	2.7
2001	6	2	7	58	45.06	29.95	36.12	2.6
2001	6	3	5	29	14.95	30.93	35.52	3.5
2001	6	4	18	3	44.44	28.78	34.77	3.5
2001	6	4	19	28	5.04	28.77	34.64	3.7
2001	6	4	20	35	38.69	28.76	34.76	2.6
2001	6	6	6	30	27.11	30.73	35.93	2.7
2001	6	8	10	48	7.09	28.79	34.71	2.6
2001	6	13	6	44	14.47	28.06	34.47	3.7
2001	8	11	18	54	23.99	28.98	34.77	2.5
2001	8	12	10	14	0.14	29	34.68	2.98
2001	8	27	10	39	38.59	29.59	35.56	3.3
2001	8	28	7	53	15.32	28.9	34.62	3.41
2001	9	24	11	14	39.4	32.1	36.3	3.3
2001	10	3	12	5	33	32.07	35	2.8
2001	10	8	11	26	1.71	29.89	35.34	4
2001	10	13	20	52	0.51	29.31	34.48	2.5
2001	10	19	2	36	21.5	28.31	34.52	2.7
2001	10	25	17	11	57.2	28.7	34.7	2.7
2001	10	26	18	42	51.9	28.7	34.7	2.7
2001	10	27	18	22	38.9	28.4	34.6	2.7

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	10	28	12	1	46.7	29.6	34.9	3.1
2001	10	29	18	53	54.5	29.3	34.9	3.5
2001	11	3	17	10	16.73	28.34	34.68	2.8
2001	11	4	10	6	58.12	28.04	34.62	2.9
2001	11	4	15	3	35.11	30.41	34.66	3.1
2001	11	8	14	5	21.1	29.6	35.45	3.1
2001	11	11	5	0	58.5	28.77	34.65	4.1
2001	11	14	5	23	48.49	28.72	34.76	2.5
2001	11	14	15	56	12.87	29.46	34.21	2.4
2001	11	16	5	1	41.34	28.38	34.77	3.8
2001	11	21	23	4	30.65	28.73	34.77	3.1
2001	11	27	21	12	58.3	28.32	35.08	3.4
2001	12	10	16	7	16.42	28.98	34.82	2.57
2001	12	21	23	18	40.52	28.46	34.94	2.8
2001	12	29	12	24	16.33	28.27	34.66	4.6
2001	12	29	14	19	40.54	28.3	34.69	3.1
2001	12	29	14	44	34.52	28.09	34.9	3.68
2001	12	29	14	47	44.93	28.12	34.61	2.9
2001	12	29	15	23	54.28	28.34	34.66	2.87
2001	12	30	0	27	46.66	28.15	34.84	3.45
2001	12	31	1	27	55.92	28.05	34.76	3.3
2002	1	2	4	33	10.8	28.4	34.6	3.1
2002	1	2	4	36	11.4	28.4	34.5	3.2
2002	1	9	12	3	1.66	28.6	34.8	3.3
2002	1	20	1	27	0.702	29	35.2	3.3
2002	1	23	12	17	13.8	29.27	35.7	3.4
2002	2	16	0	0	12.01	28.69	34.72	3.34
2002	2	16	15	21	28.41	28.8	34.78	2.8
2002	3	21	8	58	4.051	28.72	34.76	2.68
2002	3	21	16	5	29.72	28.32	34.58	3.06
2002	4	3	23	2	8.8	28.3	34.78	2.7
2002	7	16	13	44	18.3	28.71	34.85	2.9
2002	7	20	10	49	35.36	29.27	35.33	2.7
2002	7	20	14	6	8.52	29.33	35.3	2.5
2002	7	21	9	15	59.8	29.44	35.83	2.8
2002	8	8	8	53	5.017	28.74	34.74	3.4
2002	8	14	17	3	29.72	28.8	34.87	2.7
2002	9	15	11	21	44.17	29.53	35.7	3.4
2002	9	24	21	55	26.27	28.42	34.24	3.3
2002	10	1	10	5	3.57	30.6	35.7	2.9
2002	10	6	5	37	34.6	29.3	35.5	3
2002	10	6	9	30	17.2	29.3	35.3	2.8
2002	10	9	18	38	38.5	28.8	34.9	2.9

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2002	10	10	13	9	11.5	29.7	34.2	2.9
2002	10	13	12	3	37.3	30.2	35.9	2.6
2002	10	13	3	52	18.4	28.6	34.7	3.2
2002	10	16	8	44	3.7	29.8	35.1	3.1
2002	10	25	14	30	33.1	28.8	34.9	2.9
2002	11	6	7	48	21.98	29.09	34.96	3.4
2002	11	10	0	59	47.5	28.72	34.33	4.2
2002	11	11	16	43	32.2	28.4	34.9	3.3
2002	11	11	19	24	55.19	28.39	34.78	3.1
2002	11	11	22	18	13	28.44	34.8	3.7
2002	11	12	14	14	2.3	28.5	34.96	4
2002	11	14	18	44	24.2	28.21	34.72	3.4
2002	11	19	5	16	42	28.59	34.93	4.6
2002	11	21	11	23	21	28.57	34.9	4.7
2002	12	9	8	27	10.51	28	34.05	3.5
2002	12	13	7	15	46.02	28.66	34.59	3
2002	12	13	9	46	8.7	28.54	34.59	2.6
2003	1	1	12	19	50.09	31.5	35.9	3.2
2003	1	3	23	5	12.82	27.8	34.7	2.9
2003	1	4	5	33	59.77	28.8	35.5	3.5
2003	1	5	12	57	0.06	28.5	34.2	2.7
2003	1	13	12	5	39.31	30.9	35.4	2.8
2003	1	28	12	13	50.72	29	35.4	2.8
2003	2	8	18	13	28.86	28.78	34.35	3
2003	2	11	16	1	46.35	29.2	34.8	2.98
2003	2	13	15	54	0.46	30.85	34.48	3.38
2003	2	18	10	15	2.27	29.15	34.5	2.8
2003	10	27	12	15	59	30.47	34.6	2.5
2003	10	31	12	20	48	29.77	35.58	2.5
2003	11	2	4	58	39.25	28.6	34.79	2.9
2003	12	6	0	53	42.39	28.47	34.49	2.6
2003	12	6	3	27	12.17	28.3	34.26	3
2003	12	9	9	48	59.7	29.76	35	2.3
2003	12	14	13	20	41.12	30.48	34.42	2.4
2003	12	16	11	5	12.85	29.78	34.88	2.2
2003	12	22	10	53	54.75	30.64	35.92	2.5

Zone No.	**Name**	**Cooridinates**		**Area**
		Lat. N	**Long. E**	**(KM^2)**
3	**Tabuk**	**32.28**	**36.48**	**85032**

Zone No.	**Name**	**Cooridinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
		29.33	**35.62**	
		28.29	**39.75**	
		26.35	**37.73**	

Historical Events (Zone 3)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
873	9	0	0	0	0	27	38	6.5
1068	3	18	0	0	0	28.5	36.7	7
1588	1	4	0	0	0	29	36	7

Instrumental Events (Zone 3)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1974	9	6	5	17	0	29.91	35.71	4.2
1984	3	2	19	54	39	28	36.1	4.1
1994	9	5	9	53	49.78	29.85	36.17	3.4
1995	3	28	9	12	1.1	29.89	36.3	3
1995	12	10	0	31	16.76	28.79	35.49	4.3
1995	12	11	10	54	37.93	28.32	35.44	4.5
1995	12	30	5	13	29.31	28.34	35.71	4.6
2001	1	1	11	24	51	29.7	36.9	3.2
2001	1	2	13	40	51.42	31	36.9	3
2001	1	3	13	3	27.5	31	36.8	3
2001	1	4	8	9	1.8	29.8	36.5	3
2001	1	4	8	10	19.3	29	35.8	3
2001	1	7	12	44	46.2	29.5	36.1	3.3
2001	1	8	10	51	34.8	31.3	36.2	2.9
2001	1	8	12	15	20.7	29.9	37.8	2.7
2001	1	10	8	26	44	31.2	36.2	3.3
2001	1	10	12	30	6	31.6	36.5	3
2001	1	17	12	23	9	30.4	36.7	3.8
2001	1	17	14	22	49	29.4	35.9	2.9
2001	1	21	10	45	12	30.3	36.7	3.6
2001	1	22	12	9	20.3	30.4	36.9	3.3

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	1	22	14	36	9.3	30.1	36.3	3.5
2001	1	23	15	6	27.9	30.6	37.2	3.7
2001	1	27	10	34	7	29.7	36.1	3.3
2001	1	28	12	36	47	29.4	35.9	3.6
2001	1	28	13	10	28	31.2	36.2	3.2
2001	1	29	9	17	21	29.4	35.9	3.4
2001	2	2	7	58	25.47	30.05	36.68	3.22
2001	2	2	8	36	32.46	30.02	37.17	3.18
2001	2	3	12	44	11.46	31.6	36.33	2.81
2001	2	7	12	31	13.61	30.58	37.27	3.25
2001	2	8	10	9	26.67	31.07	36.32	2.86
2001	2	8	10	10	47.45	29.87	36.5	3.06
2001	2	8	10	10	42.39	30.51	37.64	3.47
2001	2	10	12	48	19.32	30.38	36.87	3.24
2001	2	11	10	38	37.52	31.07	36.65	2.98
2001	2	11	11	33	43.33	29.9	37.03	3.2
2001	2	11	11	37	15.68	30.38	36.9	3.16
2001	2	12	12	26	18.45	30.06	36.8	3.07
2001	2	12	12	52	45.42	30.6	36.5	3.1
2001	2	12	15	28	22.74	29.33	35.92	3.1
2001	2	13	12	18	15.26	30.91	36.13	3.18
2001	2	13	15	28	54.3	30.72	36.12	2.8
2001	2	17	10	31	30.21	29.96	37.04	2.77
2001	2	18	12	17	1.18	30.44	36.84	3.55
2001	2	18	15	26	12.72	30.66	36.13	3.02
2001	2	19	10	26	5.7	31.04	37.52	3.13
2001	2	19	12	37	0.24	30.06	36.7	3.15
2001	2	20	10	40	23.41	30.2	36.9	3.35
2001	2	20	11	10	5.68	30.02	36.98	3.15
2001	2	21	12	26	45.72	30.62	37.62	3.45
2001	2	22	9	59	48.9	29.94	36.89	2.75
2001	2	23	8	24	51.99	30.21	36.64	3.07
2001	2	26	10	35	50.7	29.97	36.84	2.77
2001	2	26	10	57	35.7	30.05	36.94	2.88
2001	2	28	12	4	29.99	30.15	37	3.39
2001	2	28	12	11	53.3	31.59	36.82	3.01
2001	3	2	12	22	22.96	29.52	37.28	2.88
2001	3	7	8	14	5.94	30.49	37.69	3.06
2001	3	13	12	27	16.8	31.51	36.89	2.78
2001	3	14	11	55	50.22	30.03	37.03	2.58
2001	3	19	10	25	17.19	30.1	36.74	3.37
2001	3	20	12	7	38.44	31.37	37.45	3.02
2001	3	26	12	31	2.69	30.07	36.69	2.86

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	3	27	12	22	15.96	29.45	36.05	3.26
2001	4	4	8	40	20.9	29.9	36.4	2.6
2001	4	5	3	28	46.2	29.5	35.9	2.5
2001	4	7	11	15	18.2	31.3	36.8	2.7
2001	4	8	11	26	41.58	29.7	36.6	3
2001	4	11	10	5	46.8	30.3	36.6	2.6
2001	4	11	13	39	10.5	27.2	38.5	2.7
2001	4	12	12	5	25.3	31.6	36.4	2.8
2001	4	13	7	8	47.79	30.3	36.6	2.8
2001	4	15	9	46	51.28	30.2	36.9	2.9
2001	4	16	11	31	45.1	29.7	36.5	2.9
2001	4	17	11	31	45.1	29.7	36.5	2.9
2001	4	18	7	10	15.9	30	36.4	3
2001	4	19	11	15	50.1	30.1	36.6	3.2
2001	4	21	8	44	19.7	29.6	35.9	2.9
2001	4	23	11	11	41.3	29.8	36.3	3.3
2001	4	25	11	5	29.4	29.7	36.2	3.1
2001	4	27	8	6	34.2	29.6	36	2.9
2001	6	3	8	34	19.41	30.23	36.7	2.6
2001	6	4	11	5	50.63	30.22	36.46	2.5
2001	6	5	9	22	48.99	30.1	36.81	2.8
2001	6	6	11	44	49.8	28.61	37.39	2.6
2001	6	7	10	40	38.7	30.23	36.67	2.9
2001	6	7	13	9	52.19	31.52	36.38	3.2
2001	6	8	9	19	29.33	30.2	36.5	2.5
2001	6	10	11	22	17.49	30.07	36.88	3.2
2001	6	11	9	12	48.72	29.97	36.88	2.9
2001	6	12	12	11	59.38	31.31	36.69	3.2
2001	6	13	11	4	43.65	31.62	36.89	3
2001	6	13	11	31	30.24	30.25	36.68	3.4
2001	6	15	11	32	43.93	28.66	37.43	3
2001	6	16	22	17	17.9	28.77	37.52	2.5
2001	6	17	9	48	10.32	30.3	36.14	3
2001	6	18	11	16	0.73	30.3	36.55	3.1
2001	6	18	11	18	37.78	30.29	36.6	3.2
2001	8	13	9	15	40.9	30.12	36.68	3.13
2001	8	13	11	18	39.9	30.54	36.4	2.81
2001	8	15	11	50	15.9	30.95	36.45	3.02
2001	8	16	11	4	41.5	30.2	36.72	2.77
2001	8	18	11	28	48.22	30.03	36.64	3.15
2001	8	20	11	41	13.95	30.81	36.91	3.31
2001	8	21	6	48	36.4	30.82	36.88	3.2
2001	8	22	9	45	38.7	30.6	37.4	3.1

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	8	25	7	26	1.48	30.58	36.62	3.19
2001	8	26	12	48	36.9	30.47	36.62	3.05
2001	8	27	11	11	51.5	30.76	36.32	3.25
2001	8	28	6	0	40.2	30.5	36.56	3.15
2001	9	2	11	45	42.1	29.3	37.06	2.96
2001	9	5	11	20	44.06	29.74	37.01	2.84
2001	9	5	11	39	2.7	28.62	37.44	2.92
2001	9	6	11	9	16.1	29.62	37.39	2.99
2001	9	8	11	6	44.47	31.95	36.61	3.06
2001	9	9	9	35	36.76	29.73	37.18	2.72
2001	9	10	8	10	43.01	29.78	37.18	2.95
2001	9	11	15	50	26.33	29.03	37.71	3.24
2001	9	13	11	38	22.73	30.36	36.82	3.34
2001	9	16	8	53	38.52	29.65	37.23	3.26
2001	9	17	6	34	43.57	30.17	36.81	2.95
2001	9	18	7	34	19.15	29.81	36.99	2.96
2001	9	20	8	20	57.31	29.79	37.12	2.96
2001	9	23	9	38	33.7	30.3	36.9	3.2
2001	9	23	7	10	5.3	30.3	36.8	3.3
2001	9	28	12	22	16.23	30.1	36.57	3.06
2001	9	29	9	50	33.23	30	36	3.26
2001	9	30	10	56	28.15	29.83	36.18	3.3
2001	10	1	12	42	41.6	29.4	35.93	2.9
2001	10	2	12	22	38.8	29.23	35.28	2.9
2001	10	4	12	15	54.2	29.5	35.9	2.8
2001	10	22	12	9	12.9	29.8	36.2	2.9
2001	10	22	12	11	30.5	29.7	35.9	2.8
2001	10	24	11	7	34.9	29.8	35.9	3.1
2001	10	24	12	6	30	29.9	36.2	3.1
2001	10	25	12	15	38.3	30	36.3	3.1
2001	11	1	12	5	29.87	29.74	36	2.7
2001	11	1	12	23	0.93	29.9	36.22	2.6
2001	11	2	11	33	28.07	29.92	36	2.3
2001	11	2	12	2	8.239	29.49	35.84	3
2001	11	3	8	21	10.18	29.4	35.84	2.6
2001	11	3	12	0	3.571	29.6	35.92	3
2001	11	4	12	5	44.37	29.6	35.92	3
2001	11	5	12	4	21.98	29.6	35.92	3
2001	11	6	10	7	11.58	29.74	36.07	2.9
2001	11	6	12	13	16.27	29.6	36	2.9
2001	11	8	12	7	12.3	29.6	35.92	2.9
2001	11	9	12	7	18.59	29.6	35.92	2.7
2001	11	9	12	12	11.47	29.6	36	2.8

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	11	9	12	34	43.03	29.47	35.84	3.1
2001	11	9	12	48	35.83	29.74	35.8	2.7
2001	11	11	12	9	39.79	29.76	35.92	2.5
2001	11	12	12	8	11.81	29.6	35.92	2.5
2001	11	13	12	5	45.39	29.87	36.07	2.3
2001	11	13	12	17	30.43	30.54	37.25	2.8
2001	11	16	8	15	34.72	29.67	36	2.8
2001	12	2	11	59	47.43	29.61	35.92	2.59
2001	12	5	9	16	33.28	30.06	36.28	2.87
2001	12	5	9	32	21.46	30.16	36.42	3.17
2001	12	8	11	16	27.08	31.7	36.78	3.18
2001	12	11	9	1	59.9	30.15	36.52	3.09
2001	12	12	12	5	6.76	31.66	36.4	2.6
2001	12	13	9	30	37.33	31.33	36.51	3
2001	12	13	9	57	45.71	31.22	36.17	2.72
2001	12	14	11	53	14.96	31.54	36.5	3
2001	12	14	13	11	32.82	30.11	36.5	2.85
2001	12	15	11	34	6.46	30.16	36.48	2.98
2001	12	17	10	45	55.74	30.09	36.38	2.84
2001	12	22	9	49	51.64	30.01	36.57	2.56
2001	12	22	11	26	24.66	31.26	36.4	2.56
2001	12	22	12	10	49.64	31.68	37.01	2.92
2001	12	23	10	30	5.54	30.36	36.32	2.74
2001	12	25	9	8	33.6	29.92	36.35	3.18
2001	12	25	9	17	57.88	30.09	36.54	2.51
2001	12	25	12	22	18.68	31.83	36.35	3.28
2001	12	26	9	19	50.04	29.91	36.17	2.58
2002	1	4	10	46	59.03	29.8	36.8	3.3
2002	1	14	12	2	22.5	29	35.9	3.5
2002	2	2	9	57	3.39	30.11	36.92	3.2
2002	2	3	11	34	33.28	29.74	36.62	3.2
2002	2	3	12	20	37.85	31.72	36.24	3.06
2002	2	3	12	53	58.5	31.41	36.35	3.01
2002	2	4	9	24	30	30.05	36.33	3.49
2002	2	5	11	4	0.23	30.02	36.61	2.8
2002	2	5	12	7	27.8	29.8	36.11	3.24
2002	2	5	12	21	21.5	31.6	36.61	3.34
2002	2	10	10	50	37.67	30.31	36.76	3.4
2002	2	10	12	5	44.7	30.48	36.65	3.06
2002	2	10	13	29	56.6	30.11	36.67	3.51
2002	2	12	13	30	51.1	30.1	36.79	3.34
2002	2	13	12	8	47.5	30.33	36.56	2.94
2002	2	13	12	24	7.305	30.21	36.68	3.34

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2002	2	14	12	7	32.95	30.15	36.53	3.29
2002	2	14	12	14	29.06	30.22	36.51	2.99
2002	2	15	9	55	15.91	30.02	36.55	2.82
2002	2	16	12	31	51.6	29.88	36.78	3.14
2002	2	17	12	37	24.68	30.19	36.64	3.16
2002	2	22	9	0	17.7	30.29	37.22	3.65
2002	2	22	12	4	11.06	30.26	36.64	3.31
2002	2	23	11	57	44.9	30.03	36.98	3.54
2002	2	23	12	4	44.9	30.17	36.84	3.42
2002	2	25	12	3	52.9	30.12	36.85	3.6
2002	2	25	12	7	16.85	30.19	36.73	3.1
2002	2	25	12	21	12.03	29.85	37.35	3.34
2002	2	26	12	5	15.44	30.21	36.56	2.53
2002	2	28	12	6	44.3	30.27	36.62	2.62
2002	2	28	12	52	55.8	31.49	36.32	2.91
2002	3	1	12	6	29.2	30.31	36.61	2.47
2002	3	2	11	25	36.82	29.92	36.71	2.95
2002	4	1	9	32	4.779	30.61	36.29	2.7
2002	4	2	9	59	1.96	28.6	37.25	2.8
2002	4	7	10	4	12.2	29.9	36.85	2.9
2002	4	7	10	9	15.15	29.9	36.22	2.9
2002	4	8	10	41	17	29.7	35.8	2.9
2002	4	8	12	48	49.6	31.69	36.17	3
2002	4	22	11	20	32.4	29.97	36.2	2.9
2002	4	28	8	58	5.033	28.75	37.35	2.8
2002	4	29	10	2	17.78	30.25	36.21	2.6
2002	6	2	11	30	16.05	27.9	37.3	2.9
2002	6	14	11	7	49.59	30.6	36.9	2.9
2002	6	23	11	6	33.9	30.6	36.6	2.8
2002	6	26	11	14	54.02	29.6	37	3.1
2002	7	16	11	8	47.73	30.01	36.53	3.1
2002	7	17	8	14	17.08	30.2	36.63	2.8
2002	7	22	6	58	44.09	29.64	36.04	2.5
2002	7	23	6	46	57.77	29.67	36.04	2.9
2002	7	24	9	29	55.58	31.42	36.7	2.6
2002	7	26	11	42	19.36	29.82	36.08	2.7
2002	7	28	10	55	25.86	30.09	36.54	3
2002	7	29	11	33	2.15	30.28	36.54	3.1
2002	7	30	9	30	41.13	29.66	36.06	2.8
2002	7	31	11	18	58.2	30.53	37.09	2.7
2002	7	31	11	25	19.48	29.52	35.92	2.5
2002	7	31	12	9	0.85	29.8	35.78	2.7
2002	8	1	6	11	6.4	30.1	36.6	2.67

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2002	8	2	10	29	4.37	29.93	36.39	3.14
2002	8	22	11	2	34.56	29.97	36.56	3.3
2002	8	30	7	12	0.005	29.98	36.7	3.25
2002	8	31	11	3	55.4	30.05	36.51	3.22
2002	9	1	11	8	32.12	30.3	36.46	3.2
2002	9	2	7	27	3.933	29.83	36.27	3.26
2002	9	3	8	29	7.289	30.27	36.77	2.9
2002	9	3	11	3	17.49	29.64	36.03	2.9
2002	9	3	11	52	50.48	31.93	36.97	3.1
2002	9	4	7	54	34.3	30.11	36.39	2.8
2002	9	4	9	9	26.28	30.39	36.54	2.9
2002	9	4	10	51	1.681	30.49	36.02	2.8
2002	9	6	7	28	3.086	30.26	36.9	2.8
2002	9	6	8	14	23.11	30.06	36.58	2.9
2002	9	7	12	29	19.67	31.25	36.3	2.9
2002	9	8	11	40	5.761	29.96	36.81	2.9
2002	9	9	11	18	40	29.99	37.13	3
2002	9	10	9	12	53.48	30.05	36.37	2.9
2002	9	11	10	54	34.53	28.82	37.57	3.6
2002	9	16	7	54	25.4	30.44	36.62	3.3
2002	9	17	11	19	13.12	30.16	36.59	3.42
2002	9	20	7	16	8.161	28.93	37.59	3.06
2002	9	28	8	15	18.46	30.35	36.62	3.16
2002	9	30	8	44	56.44	30.49	36.4	3.2
2002	10	1	11	21	48.6	31.3	36.8	2.9
2002	10	5	11	41	7.2	31	36.2	2.8
2002	10	7	9	23	30.5	29.9	36	3.1
2002	10	15	12	51	47.8	31.3	37.1	2.9
2002	10	17	7	19	55.6	29.9	36.2	3.7
2002	10	19	5	0	4.4	30.6	37.7	2.9
2002	10	20	11	7	50.9	29.8	36.2	3.1
2002	10	21	11	37	46.5	29.9	36.4	3.1
2002	10	22	9	45	56.4	29.9	36.4	2.9
2002	10	23	11	18	50	29.9	36.3	3.1
2002	10	24	11	2	27.3	29.6	36.9	3.1
2002	10	26	15	10	51.3	29.7	36.9	2.9
2002	10	27	11	26	16.4	29.9	36.6	2.9
2002	10	29	9	46	47.6	30	36.3	2.9
2002	10	30	12	32	17.8	30.2	36.5	2.9
2002	10	31	12	20	6.2	27.9	38.5	2.9
2002	12	1	11	2	42.52	30.07	37.02	3.4
2002	12	1	12	3	25.1	30.22	36.9	3
2002	12	2	9	53	54.76	30.36	36.78	3.4

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2002	12	2	12	57	54.82	30.21	36.64	3.3
2002	12	3	12	9	5.53	30.42	36.94	3.1
2002	12	3	13	16	13.39	31.65	36.94	3.1
2002	12	4	10	7	16.47	31.48	36.23	2.9
2002	12	4	10	58	48.83	30.25	36.72	3.3
2002	12	6	12	9	50.35	30.05	36.76	2.6
2002	12	7	11	51	53.11	30.25	36.74	3
2002	12	8	11	44	6.69	30.23	36.66	2.8
2002	12	8	12	1	31.33	30.23	36.69	3
2002	12	8	13	7	32.5	30.44	36.58	2.8
2002	12	10	12	7	17.78	27.42	36.9	2.7
2002	12	10	13	58	6.68	28.11	37.72	3.1
2002	12	11	12	2	54.37	30.62	35.95	3
2002	12	13	11	15	58.92	30.24	36.72	3
2002	12	14	12	5	59.52	30.17	36.66	3
2002	12	15	10	28	7.71	30.78	36.11	2.7
2002	12	15	11	59	10.69	30.24	36.72	3.3
2002	12	16	10	4	41.74	30.1	36.68	2.7
2002	12	16	11	58	5.9	30.32	36.68	2.8
2002	12	16	12	44	51.52	31.43	36.7	2.8
2002	12	17	12	13	25.17	31.49	36.78	2.9
2002	12	17	12	47	53.68	30.02	37.17	2.7
2002	12	18	9	40	19.45	30.17	36.81	2.5
2002	12	18	10	13	16.74	31.52	36.76	3.2
2002	12	21	9	34	24.49	30.74	36.22	2.6
2002	12	21	10	7	1.44	29.84	37.24	2.5
2002	12	21	10	53	46.19	30.15	36.89	2.8
2002	12	23	11	49	1.62	30.07	36.97	2.5
2002	12	23	12	2	37.02	30.08	36.9	2.8
2002	12	23	12	42	47.43	31.9	36.63	3
2002	12	24	8	55	42.76	30.29	36.9	2.7
2002	12	24	12	49	54.22	29.92	36.78	2.8
2002	12	25	10	23	44.86	30.33	36.77	2.5
2002	12	25	12	49	54.33	29.72	37.66	3
2002	12	27	8	6	10.58	30.09	37	2.6
2002	12	28	12	13	23.43	30.22	36.97	2.6
2002	12	29	12	20	32.71	30.8	36.02	2.8
2002	12	29	12	25	31.64	29.99	37.04	3.2
2002	12	29	12	47	10.56	31.84	36.75	3.1
2002	12	30	10	7	34.82	30.06	36.98	2.8
2002	12	30	10	29	27.39	31.35	36.56	2.9
2002	12	30	12	9	16.6	30.19	36.63	2.7
2002	12	30	13	10	30.17	32.18	36.7	3

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2002	12	31	12	4	18.16	30.3	36.95	2.7
2002	12	31	14	29	56.26	30.07	37	2.9
2003	1	2	12	7	5.31	30.1	36.5	3.6
2003	1	3	12	6	7.7	30.3	36.6	3.3
2003	1	3	12	10	26.17	31.6	36.3	3.2
2003	1	7	10	41	55.87	30.3	37	2.9
2003	1	8	10	41	11.97	30.3	37	2.9
2003	1	8	10	48	56.6	30.4	36.9	3.4
2003	1	12	12	6	13.24	30.7	36	3
2003	1	12	12	20	52.37	30.7	36	3
2003	1	14	9	58	45.23	30.2	36.7	2.9
2003	1	18	9	2	1.43	30.6	37.3	2.9
2003	1	19	12	43	12.4	29.9	37.2	2.8
2003	1	19	12	46	25.26	31.6	36.4	2.9
2003	1	21	9	8	21.38	30	36.9	2.8
2003	1	22	12	49	46.53	29.1	35.9	3
2003	1	29	10	35	49.8	29.5	36	2.9
2003	2	1	12	46	37.6	31.35	36.42	3
2003	2	3	12	23	17.51	29.96	36.66	3.46
2003	2	4	12	52	26.23	31.3	36.23	3.17
2003	2	6	12	39	8.03	31.26	36.26	3.16
2003	2	7	8	30	53.3	30.1	36.74	3.49
2003	2	7	12	49	55.9	31.43	36.26	3.16
2003	2	17	8	18	40.8	30.32	36.71	3.06
2003	2	20	10	17	40.3	30.77	36.53	2.31
2003	2	21	8	48	29.43	30.42	36.62	3.25
2003	2	22	8	7	57.6	30.14	36.64	2.9
2003	2	24	8	46	3.77	30.17	36.58	3.2
2003	2	26	12	39	26.67	31.21	36.42	3.02
2003	4	2	11	35	8.29	29.9	36.5	3.06
2003	4	3	8	28	21.9	29.9	36.2	3
2003	4	4	10	41	34.3	29.9	36.3	3.06
2003	4	4	11	22	34.5	29.28	36.33	3.06
2003	4	6	11	12	32	29.89	36.4	3.3
2003	4	7	11	25	28.5	29.9	36.64	3
2003	4	8	8	43	57.2	30	36.2	3.2
2003	4	8	9	18	33	29.8	36.2	3
2003	4	9	6	23	14	29.8	36.7	2.9
2003	4	9	11	40	0.36	30.8	37.2	3.06
2003	4	12	12	20	33.7	30	36.4	3
2003	4	13	11	14	41.7	29.8	36.3	2.9
2003	4	14	9	26	3.43	29.9	36.4	3.2
2003	4	14	12	1	36	29.9	36.2	2.9

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2003	4	14	5	38	28	29.3	37.12	2.8
2003	10	27	12	11	53.1	29.17	36.5	2.5
2003	10	28	10	51	26.02	29.79	36.1	2.6
2003	10	29	13	49	53.7	29.9	36.3	2.6
2003	10	30	12	19	27.6	29.9	36.3	2.6
2003	10	31	13	46	56.9	29.9	36.26	2.6
2003	12	1	10	7	9.73	30	36.49	2.8
2003	12	1	12	22	1.66	29.93	36.78	2.9
2003	12	2	11	58	32.71	30.04	36.84	2.9
2003	12	2	12	16	6.93	30.04	36.6	2.9
2003	12	2	12	23	42.45	30.09	36.63	2.4
2003	12	2	13	8	23.76	30.25	36.66	2.6
2003	12	3	13	1	34.13	30.2	36.55	2.3
2003	12	3	13	10	19.94	30.04	36.69	2.9
2003	12	4	8	32	57.42	31.28	36.11	2.7
2003	12	4	12	28	28.62	30.04	36.75	2.2
2003	12	4	13	26	27.5	30.05	36.55	2.4
2003	12	5	12	20	37.74	29.84	36.62	2.2
2003	12	5	13	11	29.37	29.97	36.61	2.9
2003	12	5	14	16	10.05	29.99	36.61	2.9
2003	12	6	12	30	52.79	29.95	36.62	2.9
2003	12	6	13	8	44.04	30.18	36.56	2.3
2003	12	7	10	33	9.44	30.04	36.64	2.6
2003	12	7	12	3	2.43	30.15	36.64	2.6
2003	12	7	13	5	55.53	30.12	36.67	2.2
2003	12	8	12	18	41.75	30.03	36.49	2.2
2003	12	8	13	9	21.12	30.08	36.48	2.6
2003	12	9	11	39	10.75	30	36.62	2.8
2003	12	9	13	12	38.81	30.16	36.62	2.3
2003	12	10	12	21	22.59	30.18	36.71	3.2
2003	12	11	11	58	53.76	29.92	36.71	2.5
2003	12	11	12	19	30.07	30.02	36.74	2.8
2003	12	12	7	50	20.51	30.37	36.27	2.8
2003	12	12	13	3	54.24	30.15	36.62	2.4
2003	12	13	10	22	22.76	30.2	36.69	2.7
2003	12	13	12	22	12.41	29.95	36.64	2.8
2003	12	13	13	5	28.32	30.22	36.5	2.1
2003	12	14	8	48	42.76	28.85	36.52	2.6
2003	12	14	10	30	40.98	30	36.63	2.5
2003	12	14	12	17	0.94	29.9	36.38	2.5
2003	12	16	7	59	27.41	30.21	36.64	2.6
2003	12	16	10	31	16.73	30.24	36.58	2.2
2003	12	16	12	23	2.14	30.17	36.74	2.5

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2003	12	17	8	33	9.69	30.17	36.67	2.5
2003	12	17	12	10	39.65	30.13	36.78	2.1
2003	12	17	12	14	27.34	30.06	36.66	2.3
2003	12	18	9	7	31.75	29.97	36.51	2.5
2003	12	19	12	11	59.99	30.12	36.8	2.1
2003	12	19	12	16	9.89	30.17	36.75	2.3
2003	12	20	9	58	41.91	30.28	36.5	2.2
2003	12	20	11	58	59.8	29.96	36.52	2.5
2003	12	20	12	14	2.24	29.92	36.41	2.3
2003	12	22	13	13	3.56	30.08	36.56	2.2
2003	12	23	12	13	29.44	29.97	36.61	2.7
2003	12	23	12	25	50.57	30.19	36.72	2.4
2003	12	23	12	59	13.81	30.22	36.55	2.5
2003	12	24	12	13	28.44	30.02	36.68	2.4
2003	12	24	12	15	45.55	29.95	36.42	2.6

Zone No.	**Name**	**Cooridinates**		**Area (KM^2)**
4	**Northwestern Volcanic Zone**	**26.35**	**37.73**	**98618**
		22.36	**40.81**	
		23.33	**41.72**	
		28.29	**39.75**	

Historical Events (Zone 4)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
626						24.6	39.6	5.1(F)
873	9					27.0	39.0	6.2(F)
1068	3	18	08	30		28.5	36.7	7.0

Instrumental Events (Zone 4)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2002	6	6	22	34	23.69	23.2	41.4	4.5

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
5	**Midyan-Hijaz**	**28.33**	**35..30**	**36638**
		29.33	**35.62**	
		21.72	**40.24**	
		22.36	**40.81**	

Instrumental Events (Zone 5)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1984	3	2	19	54	39	28	36.1	4.1
1996	1	24	15	5	12.95	28.84	35.18	4
1996	2	12	2	57	28.66	28.54	35.44	4.1
1996	2	12	18	23	46.53	28.36	35.53	4.2
1995	12	11	10	54	37.93	28.32	35.44	4.5
1995	12	30	5	13	29.31	28.34	35.71	4.6
1992	6	2	20	12	47.33	25.9	37.53	4.8

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
6	**Duba-Wajh Area**	**28.33**	**35.30**	**67476**
		26.62	**33.25**	
		23.82	**35.74**	
		25.62	**37.58**	

Historical Events (Zone 6)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1907	2	4	9	4		26.3	34.8	4.5
1910	3	6	18	55		26.3	34.8	4.5
1964	2	9	6	7	30	25.7	36.5	4.9
1952	3	22	4	52	33	27.2	34.5	5
1955	11	12	5	32	14	25.29	34.58	5.3

Instrumental Events (Zone 6)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1979	5	25	17	10	56.8	25.2	36.5	4.7
1982	10	14	13	40	23	26.87	34.81	4.8
1983	6	15	22	19	49	27.22	34.46	4
1984	7	2	1	46	58.9	25.25	34.56	5.1
1984	9	7	23	26	49.1	27.1	34.96	4
1985	1	13	15	8	49	27.04	34.67	4.1
1986	4	8	8	43	34.61	27.22	34.29	4.3
1987	9	6	9	5	57.1	27.07	35.2	4.9
1988	3	4	2	58	33.67	26.82	34.96	4
1989	4	4	11	32	11.84	26.9	34.92	4.4
1990	3	15	1	24	23	27.27	34.65	4.5
1990	9	13	22	10	7.15	27.16	35.12	4.6
1990	12	1	7	59	56	27.39	35.26	4.1
1991	5	15	16	4	12	28.83	34.73	4.2
1991	11	22	0	25	22	27.83	34.89	4.2
1992	2	3	21	15	17	27.54	34.69	4.2
1992	6	1	23	53	5.08	25.48	36.12	4.5
1992	9	3	17	9	25.9	27.68	34.78	4.4
1992	9	3	17	9	26	27.68	34.78	4.5
1992	9	27	19	4	29	27.39	34.82	4.5
1992	10	7	21	34	51	27.74	34.72	4.2
1992	10	29	3	25	12	27.38	34.35	4
1993	7	31	17	52	35	27.47	34.88	4.8
1993	8	3	18	56	5.3	27.93	34.88	4.5
1993	8	12	19	0	26	27.41	34.71	4.5
1993	8	15	6	24	44	27.81	35.33	4.1
1993	8	22	7	8	37.18	25.64	36.32	4.2
1993	9	20	20	17	53	27.9	34.88	4.6
1993	11	3	18	39	25	27.98	34.88	5.2
1994	8	19	1	35	51	27.7	34.71	4.3
1995	5	14	7	2	54	27.8	34.33	4.3

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1995	5	14	4	0	5.8	27.58	34.34	4.8
1995	8	4	1	14	58	24.95	36.28	4.3
1995	11	28	3	33	38	27.89	34.9	4.3
1996	4	25	21	58	50	27.04	34.91	4.2
1997	2	26	0	18	33	27.76	34.77	4.3
1997	6	4	4	38	8.7	27.31	34.61	4.3
1997	12	11	1	29	22	27.84	34.87	4.5
1998	2	27	6	39	1.8	27.69	34.88	4
1998	5	7	15	13	0.9	27.06	35.2	4.1
2001	1	10	12	25	57	28.8	35.8	3.5
2001	4	20	4	15	1.7	26.5	37.1	3.1
2001	4	30	12	53	39.2	28.7	35.9	3.1
2001	10	21	0	48	57.5	28.63	35.62	3.1
2001	12	12	19	52	36.96	28.47	36.15	2.98
2002	10	27	13	30	13.9	27.8	36.1	3.1
2003	1	2	10	32	58.44	27.3	36.6	3.4
2003	1	28	12	4	51.59	28.1	35.8	3
2003	4	11	13	9	57.7	27.9	35.7	3.06
2001	1	7	8	59	10.8	26.3	35.2	2.9
2001	1	24	10	55	47.4	27.7	34.9	3.4
2001	2	1	17	27	36.16	26	35.34	3.38
2001	3	4	22	40	31.9	27.31	34.37	2.86
2001	4	7	12	0	37.9	27.2	33.6	2.7
2001	6	14	23	19	39.82	27.02	34.18	2.6
2001	9	29	14	47	33	26.85	34.36	3.06
2001	10	7	20	43	55.9	27.2	34.7	2.8
2001	10	10	2	45	10.5	24.84	35.2	3.3
2001	11	9	2	57	25.585	27.64	35.31	3.4
2001	12	4	5	21	8.6	26.7	34.76	3.1
2002	1	13	2	28	3.823	26.7	35.3	3.75
2002	2	13	5	44	27.42	26.78	34.75	3.84
2002	2	14	7	48	46.1	27	35.61	3.16
2002	4	9	20	25	16.53	27.2	34.3	2.7
2002	4	12	10	38	15.1	27.3	34.4	2.7
2002	4	26	20	29	59.34	27.67	34.8	2.7
2002	6	17	3	17	46.914	26.6	34.9	3.2
2002	7	16	6	19	37.85	27.55	34.64	2.9
2002	7	28	7	59	2.9	26.79	34.81	2.9
2002	8	11	11	29	53.6	27.3	34.37	3.5
2002	9	8	18	10	13.875	27	34.29	3.2
2002	9	13	7	20	1.035	28.15	35.5	3.3
2002	12	7	12	13	28.21	27.42	34.39	3.2
2002	12	31	13	28	4.18	26.96	34.64	3.5

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2003	12	5	23	32	15.24	26.54	34.49	2.6

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
7	**Yanbu**	**23.82**	**35.74**	**49614**
		25.62	**37.58**	
		21.34	**37.22**	
		23.37	**39.26**	

Historical Events (Zone 7)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1121	0	0	0	0	0	23.5	37	6.8

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
8	**Southern Red Sea-Jeddah**	**21.34**	**37.22**	**78009**
		23.37	**39.26**	
		18.20	**38.82**	
		19.58	**41.42**	

Historical Events (Zone 8)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1956	6	25	20	10	27	20.31	37.95	4.7
1408	0	0	0	0	0	21.4	39.8	4.8
1931	5	1	9	48	29	18	37.5	5.5

Instrumental Events (Zone 8)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1965	12	30	8	54	13.5	18.7	39.3	4.1
1967	3	11	19	33	48.2	19.57	38.98	4.9
1967	3	11	19	38	21.5	19.5	38.77	5.2
1967	3	12	10	1	49	19.64	39.05	5.8
1967	3	12	21	44	33.3	19.44	38.85	6.1
1967	3	12	18	35	22.4	19.62	38.68	6.1
1967	3	13	8	10	54.8	19.57	38.78	5
1967	3	13	11	46	29.6	19.67	38.75	5
1967	3	13	19	22	19	19.67	38.75	5.7
1967	3	13	7	28	4.9	19.55	38.61	5.8
1967	3	14	21	52	7.8	19.63	38.78	5.6
1967	3	16	14	45	12.8	19.43	38.75	5.1
1967	3	16	2	41	38.3	19.69	38.79	5.1
1967	3	16	3	11	59.3	19.47	38.73	5.4
1967	3	16	16	0	15.9	19.68	38.78	6.2
1967	3	21	23	39	23.9	19.7	39.23	6.1
1967	3	22	22	59	50.5	20.28	38.68	5.6
1967	3	24	12	34	31.1	20.11	38.65	4.9
1967	3	24	1	57	49.2	20.17	38.33	5
1967	3	24	1	57	49.2	20.17	38.33	5
1967	3	24	6	38	8.5	19.94	38.47	5.5
1967	3	27	19	53	42.5	20.01	38.46	5.1
1967	3	28	2	41	33.5	19.86	38.71	6.7
1967	3	31	3	18	23.6	19.96	38.41	4.9
1967	4	3	7	38	30.4	20.07	38.7	5.2
1967	4	15	16	59	6.6	20.75	38.58	4.9
1967	5	17	17	50	39.2	19.68	38.68	5.4
1967	6	19	14	35	20.2	20.6	38.4	4.5
1967	7	14	3	11	28.2	19.8	38.9	4.7
1975	6	29	21	45	59.3	18.74	39.77	4.8
1975	6	29	15	1	16.1	19.05	39.46	4.8
1976	1	31	2	36	9.1	18.8	39.39	4.2
1976	3	18	17	39	40.4	19.23	39.04	4.4
1976	3	19	0	49	57.9	19.17	39.04	4.3
1976	4	22	16	29	0	19.92	38.57	4
1979	5	13	20	55	40.3	18.86	39.19	4.5
1979	5	13	20	48	0.3	18.76	39.3	4.8
1993	3	4	19	10	18.9	19.81	38.69	4.6
1993	3	9	12	59	35.64	19.79	38.7	4.7
1993	3	9	20	43	30.9	19.61	38.66	4.8
1993	3	10	0	29	14.3	19.73	38.7	4.6
1993	3	11	0	18	53.6	19.79	38.65	4.3
1993	3	11	21	58	22.1	19.71	38.66	4.5
1993	3	11	22	58	6.7	19.83	38.75	4.5

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1993	3	11	14	21	14.4	19.7	38.73	4.8
1993	3	11	16	8	13.66	20.3	39	4.9
1993	3	11	8	19	46.1	19.54	38.67	5
1993	3	12	3	47	16.3	19.74	38.75	4.3
1993	3	12	19	22	1.3	19.86	38.75	4.3
1993	3	12	14	43	39.32	19.91	38.2	4.3
1993	3	12	5	12	2.6	19.51	38.71	4.6
1993	3	12	0	19	17.2	19.77	38.7	4.6
1993	3	12	23	32	46.4	19.63	38.65	4.7
1993	3	12	4	24	19.3	19.57	38.74	5.1
1993	3	13	19	15	31	19.92	38.94	4
1993	3	13	8	9	59.3	20.06	38.96	4.4
1993	3	13	5	40	44.3	19.62	38.71	4.7
1993	3	13	13	59	59.1	19.4	38.78	4.9
1993	3	13	17	12	26.2	19.62	38.8	5.7
1993	3	14	8	42	6.3	19.93	38.76	4.2
1993	3	14	14	49	18	19.56	38.64	4.7
1993	3	15	23	33	45	19.68	38.86	4.2
1993	3	15	4	57	33	19.44	38.76	4.7
1993	3	15	8	57	55.4	19.43	38.71	4.9
1993	3	15	1	38	13.3	19.49	38.74	5
1993	3	16	6	59	5.9	19.42	38.71	4.7
1993	3	16	11	59	26.4	19.52	38.77	5.4
1993	3	17	21	7	36.5	19.4	38.98	4.1
1993	3	17	21	19	29.2	19.03	38.7	4.2
1993	3	17	17	25	2.3	19.71	38.97	4.2
1993	3	17	1	3	40.5	19.48	38.78	4.3
1993	3	19	1	1	35	19.96	38.25	4.1
1993	3	19	12	11	49.8	20.02	38.92	4.4
1993	3	19	0	20	47.5	19.61	38.75	4.6
1993	3	20	6	5	2.99	19.57	38.81	4.7
1993	3	20	5	49	45	17.98	39.35	4.9
1993	3	22	20	51	37.7	19.53	38.86	4.9
1993	3	23	21	35	11.4	19.48	38.87	4.4
1993	3	23	4	5	22.09	19.52	38.7	4.8
1993	3	23	0	59	32.9	19.59	38.69	5.2
1993	3	24	18	37	10.7	20.41	38.6	4.5
1994	3	14	19	41	40	19.41	38.54	4.7
1996	7	31	18	46	11.76	19.08	39.16	4.1
1996	9	5	4	17	16.2	18.95	39.26	4.8
1996	11	2	13	50	33.3	19.23	39.25	5.3
1998	3	27	2	17	2.04	21.02	38.23	4.5
1998	5	9	7	11	43.87	18.54	39.55	4.6
1998	7	19	2	19	59.75	19.03	39.3	4.2

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
2001	8	11	12	40	45.4	22.42	36.95	4.09
2001	3	9	3	23	58.64	19.47	39.89	2.98
2002	10	13	20	40	53.5	20.1	38.1	4.1

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
9	**Makkah Region**	**21.72**	**40.24**	**44958**
		23.33	**41.72**	
		18.83	**41.84**	
		20.62	**43.35**	

Historical Events (Zone 9)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1269	10	29				21.1	40.5	4.8 (F)
1408						21.5	39.8	4.6 (F)

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
10	**Southern Red Sea-Al Darb**	**18.20**	**38.82**	**112358**
		19.58	**41.42**	
		15.88	**43.44**	
		12.65	**42.98**	

Historical Events (Zone 10)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG

1955	3	3	0	43	40	16.46	41.29	4.5
1958	1	9	7	56	27	17.71	40.12	4.5
1960	10	23	19	21	8	17.5	40.1	4.5
1959	8	16	13	31	0	14.54	43.14	4.6
1962	8	25	0	54	17	17.1	40.1	4.7
1931	2	18	2	12		14.8	42.2	4.8
1958	2	13				14.35	42.1	4.8
1941	2	4	9	17	44	16	43	5.2
1960	12	16	16	49	15	14.8	42.5	5.3
1962	11	11	15	15	33.6	17.2	40.7	5.3
1432	12	0	0	0	0	15	43	5.7
1915	3	18	21	0	30	14	42	5.7
1913	2	27	16	22	54	17.5	39	5.8
1906	3	20	3	48		17	41	6.1
1788	11	0	0	0	0	14.2	42.6	6.2
1432	5	20	0	0	0	14	42.5	6.3

Instrumental Events (Zone 10)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1967	9	21	18	36	26.1	17.9	40	4.4
1969	9	26	4	54	35.7	16.43	40.98	5.4
1974	4	17	18	27	33.7	17.26	40.37	5.2
1974	4	26	18	8	16.9	17.14	40.38	4.8
1974	6	30	13	26	24.7	16.01	39.63	4.4
1975	8	7	22	43	13.3	15.29	40.41	4.6
1975	12	14	23	16	47.6	14.62	42.24	5.3
1975	12	14	23	27	25.9	14.74	42.32	5.3
1976	11	7	20	21	47.4	15.97	41.47	4.7
1976	11	7	5	53	7.6	15.82	41.42	4.8
1976	11	16	12	53	33.7	15.91	41.92	4.9
1976	12	1	11	59	34.5	15.87	41.68	4.8
1977	6	27	14	13	20.2	16.15	40.01	4.3
1977	12	28	2	45	33.7	16.66	40.28	6.3
1978	1	4	5	4	43.1	16.69	40.85	4.5
1978	1	17	15	0	27.4	16.52	40.26	5.2
1978	2	21	22	4	42.3	16.46	40.39	4.7
1978	3	25	2	55	4.2	16.53	40.26	5
1979	8	13	16	17	50	15.27	42.03	4.4
1979	8	15	2	20	43.2	15.39	41.7	4.7
1980	1	14	4	21	49.2	16.55	40.08	4.5
1980	1	14	12	57	15.4	16.32	40.17	4.7
1980	1	14	12	28	22.6	16.45	40.23	5.3

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1980	1	14	4	10	54	16.52	40.27	5.4
1980	1	26	6	15	30.4	16.37	40.14	4.6
1980	3	5	3	12	5.2	16.61	40.24	4.9
1980	4	7	16	45	38	17.6	40.2	4.8
1980	7	12	12	59	4.5	17.19	40.27	4.3
1980	7	16	23	14	56.7	17.25	40.44	4.8
1980	7	17	0	12	50.9	16.63	40.47	4.3
1980	7	17	0	8	19.1	17.41	39.97	4.6
1983	8	7	10	42	18.35	16.45	41.33	4.5
1987	9	11	0	48	16.45	16.99	40.34	4.8
1988	4	6	3	11	22.64	16.37	41.66	4.8
1988	4	8	22	32	37.8	16.34	41.12	4.6
1988	11	1	23	51	4.95	16.79	40.61	4.2
1988	11	1	19	19	47.13	16.54	41	4.7
1988	11	2	14	6	36.14	16.48	40.97	4.4
1988	11	2	19	6	48.27	16.6	40.85	4.5
1988	11	2	0	57	13.69	16.63	40.76	4.6
1988	11	3	1	19	37.58	16.45	40.98	4.5
1988	11	3	19	27	22.43	16.47	41.02	4.6
1988	11	3	7	55	9.48	16.49	41.02	4.7
1988	11	3	19	50	58.59	16.54	41.08	4.8
1988	11	4	1	2	56.43	16.63	40.94	4.4
1988	11	6	15	0	8.16	16.58	41.15	4.6
1988	12	10	17	33	19.97	16.32	41.1	5.2
1990	6	7	22	18	24.33	17.61	40.47	4.5
1990	6	8	3	17	2.07	17.53	40.97	4.5
1991	3	31	23	19	26.98	19.51	38.73	4.6
1993	5	4	2	23	18.19	16.44	39.68	4.3
1993	5	7	3	58	18.13	15.91	42.63	4.4
1993	6	16	11	10	14.68	17.29	39.95	4.7
1993	7	3	1	37	17.53	17.86	39.98	4.9
1994	5	11	10	8	4.18	15.75	41.38	4.5
1994	5	13	10	56	14.63	16.04	41.81	4.7
1994	5	14	22	34	35.65	15.21	42.06	5
1994	5	16	12	10	26.75	15.3	42.1	4.7
1994	5	25	1	33	46.3	15.55	41.86	4
1994	5	25	2	22	16.22	15.66	41.53	4
1994	6	21	2	12	24.64	15.33	41.61	4.8
1995	6	24	8	41	29.2	16.51	39.86	4.8
1996	4	7	5	57	21	15.2	42.15	4.1
1996	4	30	3	41	41.2	14.91	42.3	4
1996	4	30	17	36	8.63	15.3	42.1	4.1
1996	5	1	11	45	14.8	14.5	41.89	4.3
1996	5	2	23	12	18.19	14.47	41.75	4.3

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1996	5	5	20	42	18.3	15.23	41.6	4.4
1997	7	13	16	13	8.57	15.29	41.93	4.2
1997	7	13	18	50	38.08	15.19	42	4.2
1997	7	14	13	29	18.38	15.49	42.22	4.4
1998	5	13	0	27	51.38	14.32	42.03	4.9
1998	5	13	9	59	0.39	13.98	42.06	5.1
1999	4	29	14	57	23.41	17.93	40.13	4.5
1999	4	29	17	54	32.78	18.03	39.92	4.5
2001	3	15	4	7	54.41	20.55	42.55	2.89
2001	4	29	12	41	18.3	22.3	41.5	3.8

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
11	**Abha-Jizan**	**18.83**	**41.84**	**44958**
		20.62	**43.35**	
		15.88	**43.44**	
		17.32	**45.27**	

Historical Events (Zone 11)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1955	10	17	20	8	53	17.2	43.6	4.8
1941	2	4	9	17	44	16	43	5.2
1619	7	12	0	0	0	16.4	44	5.8
1881	6	0	0	0	0	16.9	43.8	5.9
1941	1	11	8	31	0	16.4	43.5	5.9

Instrumental Events (Zone 11)

YR	MON	DAY	HR	MIN	SEC	LAT	LON	MAG
1993	3	26	18	50	53.66	18.38	44.36	3.9

1995	6	29	23	13	11.33	16.96	43.58	4.4
1993	1	9	17	54	4.31	17.16	45.02	4.5
2001	5	3	19	3	21	15.6	43.1	3.4
2002	6	29	18	52	6.351	14.3	41.7	3

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
12	**Southwestern Arabian Shield**	**15.88**	**43.44**	**67323**
		12.65	**42.98**	
		17.32	**45.27**	
		13.66	**46.18**	

Historical Events (Zone 12)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
742						15.3	45.5	6.5
827						14	44.5	6.1
1072						14.4	43.7	6
1145	9	15				14	44	5.7
1154						14.1	44.1	5.9
1259	12	10				15.4	43.7	6.5
1265						15.4	44.2	4.9
1315			12	0		14.2	43.9	6.3
1336						14.2	43.2	4.8
1387	9	5				13.3	448	6.4
1394	3					13.3	43.5	5
1413	12					14.1	44.2	6.4
1463						14.2	43.3	6.4
1466	12	15	5	0		14.2	43.3	5.7
1484	5	9	12	0		14.2	43.3	5.8
1485	3					14.2	43.5	5.2
1501	1	26	5	0		14.2	43.3	4.6
1502	11	13	0			14.2	43.5	4.8
1504	8	30	0			12.5	43.5	6.6
1509	5	7	5	0		14.2	43.3	4.8
1511	1	20	6	0		14.2	43.3	5
1511	1	29	0			13.6	43.5	5.6
1511	2	27	16	0		13.6	43.5	5.6
1511	6	11	4	0		14.2	43.3	4.9

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1631	3					15.4	44.2	4.8
1646	4	30				15.5	43.9	4.9
1666	11		5	0		15.4	44.2	4.9
1667	3	14	22	0		15.4	44.2	5.9
1674	8					14.8	44.2	4.9
1675	12	21	5	0		15	44.2	5.3
1775	6	3	19	0		13.9	43.5	4.9
1850	7	17				15.4	44.2	6.4
1859	1					13.1	44.1	5.2
1873	10	9	21	0		14.2	43.3	4.8
1878	6					14.5	44.4	6.5
1896	6	22	30			15.4	44.2	4.8
1897	2	20	15	20		13	43	4.6
1908	1	25	20	4		15	44	5.6
1911	5	13				14.1	43.3	5.4
1924	10	4	6	41	5	15	44	5.2
1937						14.4	44.5	4.8
1959	8	16	13	31	15	14.5	43.1	4.6

Instrumental Events (Zone 12)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1982	12	13	16	28	34.69	14.69	44.4	4
1982	12	13	17	57	10.27	14.73	44.09	4.6
1982	12	13	9	12	51	14.7	44.38	6
1982	12	15	29	26	56.92	14.6	44.59	4.2
1982	12	21	10	5	1.77	14.61	44.61	4.7
1982	12	29	23	53	15.43	14.65	44.46	5.3
1983	1	8	23	51	53.62	14.65	44.41	4.6
1984	6	25	2	6	43.28	13.82	44.66	4.7
1984	9	23	21	23	41.43	14.86	44.34	4.8
1991	11	22	0	40	2396	13.89	44.07	4.7
1992	5	19	1	26	44.62	13.84	44.03	4.5
1993	1	9	17	54	4.31	17.16	45.02	4.5
1993	11	1	0	27	55.16	13.86	43.51	3.9
2001	4	10	23	49	24.1	17.9	43.3	3.5

Zone	Name	Coordinates	Area

No.		Lat. N	Long. E	(KM^2)
13	**Gulf of Aden**	**12.65**	**42.98**	**335851**
		10.37	**44.23**	
		16.12	**54**	
		14.05	**54.61**	

Historical Events (Zone 13)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1504	8	30	0			12.5	43.5	6.6
1613						12.6	45	5.6
1789						12.5	44	5.9
1887	4	1				12.8	45	4.9
1907	7	20	3	37		12.8	45	4.8
1916	6	21	0	59		15.7	52.1	4.8
1923	12	10	23	53	28	13.5	50	5.2
1924	4	20	14	26	54	14.5	52	6.1
1924	10	19				11.3	43.5	4.8
1927	2	26	23	54	24	13.5	50	4.4
1928	3	19	10	2	6	14.5	53.5	5.6
1928	9	18	19	52	37	14	52	5.9
1929	3	16	12	30	40	14.2	53.8	4.9
1929	4	28	4	58	32	14.5	54	5.2
1931	6	23	12	12	53	13.5	52	5.2
1932	6	11	8	32	56	15	53.5	5.4
1934	9	5	2	21	3	14	49	5.3
1940	8	13	5	20	11	13.5	51.5	5.2
1941	7	17	23	34	30	14	52	5.4
1941	9	25	3	45	47	14.5	53.5	5
1942	12	21	21	21	30	14	52	5.2
1946	6	16	10	4	55	14	52	5.3
1946	8	24	0	29	24	13.5	51.5	5.5
1946	9	29	20	22	7	13	48	5.6
1947	5	24	15	11	40	12.1	48.7	5.3
1947	5	24	0	10	23	12.1	48.7	5.5
1950	5	9	6	10	30	12	47.3	5.5
1951	7	3	18	16	1	12.2	45.8	5.3
1951	7	3	5	23	46	12.2	45.8	5.5
1954	1	11	22	45	6	13.7	51.2	5.4
1958	5	24	23	53	38	12.1	43.6	5.2
1958	5	25	2	53	48	12.1	43.4	4.9
1958	6	28	17	5	16	11.9	45.4	4.6

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1958	11	4	5	6	12	14.1	53.6	4.6
1958	12	4	10	25	48	13.8	51.7	4.9
1959	1	5	8	17	15	13.7	51.6	4.9
1960	3	25	9	45	40	12.1	46.4	5.2
1960	8	8	12	28	8	12.1	44.5	5.3
1961	2	7	2	57	53	14.6	53.9	5
1961	6	20	3	21	29	12.2	44.3	5.3
1961	8	3	0	41	31	14.5	52.2	4.7
1961	11	10	13	52	33	13.2	51.7	4.7
1961	12	8	10	40	38	13.4	50.2	4.7
1962	5	24	8	28	12	13.2	48	4.7
1962	6	24	15	8	24	13.3	48.9	4.9
1962	7	15	21	52	20	14.1	53.5	4.8
1962	9	1	0	38	13	12.7	48.1	4.7
1962	12	21	17	47	26	13.9	51.6	5.3
1963	2	7	16	45	6	14.5	53.5	4.6
1963	11	1	7	2	35	14.2	53.6	5
1964	7	20	13	31	12	14.1	53.7	4.8
1964	9	7	11	27	13	15.1	53.4	5.2
1964	10	14	17	26	3	14.5	53.7	4.8

<u>Instrumental Events (Zone 13)</u>

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1965	3	7	7	42	31.2	12.1	46.3	4.9
1965	3	7	7	32	38.1	12.1	46.3	5.2
1966	1	21	12	39	42.5	12.1	43.8	4.7
1966	4	18	8	14	16.6	12.9	48.4	5.3
1969	12	14	23	53	55.9	12.41	48.08	4.4
1971	4	15	18	57	24.3	12.86	48.53	5
1973	4	4	21	51	58.4	12.16	46.19	4.5
1973	4	5	19	24	1.6	12.25	46.42	5
1973	4	13				11.94	43.79	4.8
1974	6	21	16	3	57.2	12.81	46.84	4.5
1976	2	10	1	40	50.5	12.65	48.02	4.6
1978	6	22	21	41	5.3	12.53	48.02	4.7
1978	9	14	7	14	17	12.07	47.21	4.7
1978	9	14	5	1	41.3	12.81	47.78	4.7
1978	9	14	19	3	45.1	12.52	47.83	4.8
1978	9	15	12	17	50.9	12.44	47.92	5

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1978	9	25	16	55	42.3	12.59	48.01	4.5
1978	11	17	20	34	1.4	12.67	48.19	4.8
1978	12	7	16	22	3	12.94	49.79	4.5
1979	9	9	16	47	23.3	12.06	46.12	4.6
1979	9	10	20	57	25	12.02	46.03	4.9
1979	9	24	23	41	36.1	12.67	48.32	5.1
1979	10	16	18	11	32.1	11.82	43.69	5.1
1979	10	16	13	18	50.5	11.84	43.61	5.1
1979	10	16	23	41	38.7	11.78	43.47	5.2
1979	10	16	20	34	59	11.8	43.47	5.2
1979	10	16	20	45	54.4	11.61	43.86	5.3
1979	10	16	15	57	50.8	11.83	43.58	5.3
1979	10	16	20	54	46.1	11.66	43.79	5.7
1979	11	12	23	34	31.9	14.83	53.42	4.7
1980	8	31	22	5	33.3	12.13	46.01	4.7
1980	9	2				12.17	45.98	4.8
1981	1	19	8	13	49.7	12.49	47.93	4.9
1981	4	17	21	54	12	13.68	49.79	4.7
1981	7	3	20	58	20.5	13.22	49.38	4.8
1985	7	20	13	12	5.44	12.56	48.26	4.8
1986	5	23	9	51	24.46	12.7	48.18	5.5
1987	5	17	2	25	25.42	12.59	45.23	4
1989	6	4	12	2	35.94	11.7	43.98	4.9
1989	8	1	18	34	28.41	12.45	47.46	4.2
1991	4	13	13	23	15.43	12.51	48.21	4.3
1991	5	11	15	26	29.74	12.41	47.52	5.2
1991	5	12	16	12	37.1	12.28	47.49	5.3
1992	12	4	0	38	18.34	12.13	46.3	4.6
1995	8	7	7	9	34.16	12.05	44.32	4.5
1995	8	20	12	0	49.82	12.16	44.19	4.5
1995	9	25	13	27	9.19	12.55	47.37	4.4
1995	9	26	1	27	11.92	12.13	46.01	4.7
1996	6	2	4	50	38.22	12.19	46.56	4.3
1996	6	16	4	57	23.68	12.04	43.79	4.2
1996	6	16	2	46	0.14	12.08	43.89	4.4
1996	6	23	2	16	41.47	12.24	46.76	4.2
1996	12	28	17	50	15.01	12.44	47.89	4.1
1997	3	9	3	37	29.78	12.04	43.42	4.1
1997	3	9	2	2	1.64	11.96	43.41	4.2
1997	3	9	13	34	12.94	11.97	43.4	4.6
1997	3	9	17	40	18.37	11.7	43.55	5.5
1997	3	10	8	50	9.14	11.88	43.54	4.3
1997	3	10	9	40	39.89	12.19	43.6	4.3
1997	6	12	14	16	41.42	12.75	48.34	4.4
1998	11	23	19	16	45.54	12.35	47.56	5
1998	11	24	0	50	44.29	12.41	47.57	4.7
1999	4	20	18	28	16.51	12.67	47.58	4.8

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1999	4	20	19	13	20.15	12.98	47.63	4.8
2001	1	21	10	3	9	14.3	44.5	3.1
2002	9	1	17	14	55.369	14.3	52.01	5.5

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
14	**Sirhan-Turayf-Widyan Basins**	**32**	**36.2**	**343516**
		32	**47.2**	
		26.5	**41.5**	
		28	**39.5**	

Historical Events (Zone 14)

Year	Mon	Day	HH	Min	Sec	Lat.	Long.	Mag.
551	7	9	0	0	0	32	36	5
1953	7	9	21	23	48	30	42.5	4

Instrumental Events (Zone 14)

Year	***Mon***	***Day***	***HH***	**Min**	**Sec**	**Lat.**	**Long.**	**Mag.**
1965	7	20	7	31	0	30.12	37.86	3.6
1982	1	6	22	56	5.2	29.55	39.16	3
1983	10	24	23	29	22.1	31.57	37.24	3.1
1987	2	5	13	32	25.6	31.25	37.74	3.1
1988	3	2	7	55	46.9	31.81	37.45	2.8
1989	3	31	0	44	14.5	31.88	37.46	5.4
1989	3	31	1	2	38.3	31.92	37.87	3.2
1989	4	11	9	41	28.4	31.93	37.61	2.7
1994	10	8	0	0	0	29.57	43.3	3.7
1995	1	1	13	1	36.35	31.21	37.28	2.6
1995	1	3	10	26	28.25	30.89	37.01	2.9
1995	1	3	13	5	40.7	31.44	36.55	2.7
1995	1	7	12	56	32	32	36.2	3
1995	1	9	15	16	19.82	31.48	36.52	2.4
1995	1	17	7	20	54.8	26.69	41.68	1.2
1995	1	18	13	24	51	31.79	37.26	2.7

Year	*Mon*	*Day*	*HH*	Min	Sec	Lat.	Long.	Mag.
1995	1	25	8	46	11.41	31.53	36.54	2.4
1995	1	28	12	56	36.43	30.78	37.26	2.5
1995	1	28	10	49	17.33	31.75	36.94	2.6
1995	2	5	7	34	20.08	30.89	37.16	3.4
1995	2	6	12	12	48.61	31.41	36.69	2.8
1995	2	10	11	57	18	30.95	37.49	2.6
1995	3	2	2	47	33.77	28.56	42.73	2.9
1995	3	15	9	20	28.1	28.9	39.69	2.4
1995	4	1	4	47	50	31.2	45.93	4.6
1995	7	1	11	5	40.76	31.71	36.31	2.7
1995	7	4	7	12	57.9	31.12	37.65	3
1995	7	8	8	55	50.55	31.67	36.64	2.9
1995	7	12	11	54	13.8	31	37.58	2.9
1995	8	24	18	0	14.9	31.24	39.53	4.6
1995	9	26	6	27	42	29.17	43.62	2.6
1995	12	6	17	57	52	28.67	43.56	4.9
1996	7	6	11	23	27.03	31.63	36.7	3.6
1996	7	8	11	10	13.5	31.67	37.45	3.1
1996	7	9	11	14	20.28	31.5	37.2	3.1
1996	7	10	8	12	8.99	31.56	36.98	3.3
1996	7	11	12	6	26.47	31.29	36.74	3
1996	7	18	11	10	22.93	30.99	37.61	3.3
1996	7	24	11	17	49.88	30.92	37.03	3.3
1996	9	6	10	2	23.46	29.9	39.1	3
1996	9	10	11	16	35.02	31.24	37.88	3.4
1996	9	11	11	35	26.14	31.09	37.88	3.2
1996	9	11	11	58	5.74	31.74	37.88	3.2
1997	2	9	12	14	29.76	30.99	37.56	3
1997	2	17	12	7	18.44	31.51	37.34	3.2
1997	2	18	12	11	37.66	31.27	37.45	3
1997	3	2	12	13	5.1	31.8	36.67	3.2
1997	3	4	13	5	59	31	37.12	2.7
1997	3	8	12	23	36.7	31.72	36.71	3.2
1997	5	3	11	50	16.55	31.21	37.18	2.8
1997	6	2	7	26	16.36	31.01	37.61	2.8
1997	6	2	8	56	38.38	31.49	36.62	3
1997	6	14	9	29	38.91	30.96	37.28	2.5
1997	6	18	11	16	5.9	31.81	36.46	2.8
1997	6	21	12	0	51.18	31.24	36.99	2.7
1997	6	22	12	22	57.04	31.18	37	2.7
1997	6	25	12	1	38.26	31.24	37.29	2.6
1997	6	25	19	41	23.15	28.52	42.92	4.5
1997	7	1	2	14	27.5	29.34	38.86	3
1997	7	2	11	0	52.16	31.71	36.68	2.8
1997	7	12	11	32	59.8	31.57	36.49	2.8
1997	7	16	11	57	49.2	31.2	36.89	2.5

Year	*Mon*	*Day*	*HH*	Min	Sec	Lat.	Long.	Mag.
1997	7	19	11	40	13.2	31.44	36.83	2.9
1997	7	22	12	3	51.2	31.37	36.72	2.6
1997	7	23	12	3	51.2	31.37	36.72	3
1997	7	28	11	12	44.47	31.55	36.46	3.3
1997	8	1	11	57	11.87	31.54	36.65	1.8
1997	8	3	8	20	52.7	31.36	36.66	2.8
1997	8	4	10	29	24.4	31.94	36.32	3.1
1997	8	5	11	24	18.1	31.97	36.4	3.1
1997	8	7	11	1	9.03	31.75	36.47	3.2
1997	8	25	10	52	46.4	31.63	36.93	2
1997	8	26	11	57	35.4	31.45	36.73	2.2
1997	8	31	12	5	41.83	31.58	36.56	2
1997	9	8	11	37	54.6	31.74	36.66	2.8
1997	9	13	11	12	32.61	31.7	36.56	2.9
1997	9	21	4	51	29.44	28.59	43.25	3.2
1997	9	22	12	17	35	31.56	36.44	2.8
1997	9	29	12	9	0	31.49	37.13	3.1
1997	10	1	12	13	40.98	31.46	37.2	3
1997	10	3	13	10	23.65	31.52	36.92	2.7
1997	10	8	12	17	33.7	31.23	37.42	2.8
1997	10	9	12	12	33.92	31.4	37.03	2.9
1997	11	1	12	56	16.64	30.75	37.34	2.7
1997	11	2	12	29	13.12	31.19	37.44	2.7
1997	11	9	9	47	58.87	30.83	37.2	2.9
1997	11	11	12	9	43.71	31.26	37.32	3.1
1997	11	24	13	4	54.71	30.91	37.14	2.6
1997	11	26	12	16	2.1	31.31	37.22	2.8
1997	11	29	12	11	12.47	31.33	37.34	3
1997	12	1	12	7	31.57	31.01	37.9	2.7
1997	12	9	12	16	27.29	31.28	37.13	2.5
1997	12	12	12	36	15.75	30.01	38.96	2.8
1997	12	15	9	30	15.37	30.91	37.1	3
1998	1	8	12	11	9.62	31.79	36.26	3.6
1998	2	14	10	43	39.69	31.45	36.55	2.9
1998	2	15	12	36	40.26	31.58	36.97	2.9
1998	2	16	11	9	12.09	31.01	37.49	2.8
1998	2	16	13	16	2.75	31.27	37.41	2.7
1998	2	16	13	14	51.47	31.28	37.61	2.6
1998	2	16	8	59	38.46	31.41	36.72	2.7
1998	2	23	12	10	18.68	31.72	36.31	3
1998	2	24	13	8	43.33	31.22	36.99	2.6
1998	2	26	12	15	34.17	31.55	37.13	2.8
1998	3	9	12	14	33.85	31.6	36.75	3
1998	3	21	12	10	55	31.92	36.1	2.9
1998	3	29	12	16	21.05	31.36	36.71	3
1998	5	1	12	3	40.72	31.29	36.73	2.8

Year	*Mon*	*Day*	*HH*	Min	Sec	Lat.	Long.	Mag.
1998	5	1	11	18	43.22	31.4	36.77	2.6
1998	5	2	12	29	13.63	30.91	37.07	2.9
1998	5	2	11	28	54.72	31.6	36.63	2.9
1998	5	8	11	13	31.1	31.5	36.7	2.6
1998	5	12	11	13	14.8	31.97	36.37	2.8
1998	5	15	11	28	22.05	31.48	36.53	2.9
1998	5	27	11	14	48.93	31.41	36.67	2.9
1998	5	28	11	17	54.11	31.45	36.65	2.5
1998	6	15	11	10	15.98	31.45	37.1	2.9
1998	6	18	11	19	2.62	31.17	36.86	2.9
1998	6	20	11	26	8.74	31.32	36.9	2.8
1998	6	21	11	11	8.42	31.4	36.73	2.8
1998	7	1	11	17	34.86	31.85	36.4	3
1998	7	2	15	11	38.06	31.54	36.46	2.7
1998	7	2	11	17	34.88	31.93	36.15	2.5
1998	7	3	11	20	41.05	31.74	36.29	2.6
1998	7	4	11	11	10.59	31.7	36.36	2.9
1998	7	6	11	16	17.02	31.5	36.6	2.9
1998	7	7	8	54	31.62	31.57	36.46	2.7
1998	7	7	11	16	42.39	31.6	36.53	2.9
1998	7	11	11	10	22.38	31.72	36.29	3
1998	7	14	11	17	34.98	31.82	36.4	3
1998	7	16	11	12	49.18	31.56	36.54	2.6
1998	7	17	11	36	14.81	31.46	36.71	2.8
1998	7	24	11	13	12.77	31.66	36.51	3.4
1998	7	27	11	13	5.34	31.78	36.58	2.9
1998	7	29	12	38	5.27	31.46	36.59	2.9
1998	7	30	11	15	56.98	31.71	36.58	2
1998	8	5	11	11	13.46	31.93	36.46	3.2
1998	8	13	11	12	27.41	31.97	36.24	3.4
1998	9	1	11	11	15.59	31.5	36.52	2.9
1998	9	5	11	11	5.04	31.38	36.65	3.1
1998	9	6	11	13	15.1	31.25	37.35	3
1998	9	8	11	21	25.9	31.66	36.45	3
1998	9	10	11	19	40.2	31.88	36.13	2.8
1998	9	14	11	12	53.6	31.6	36.56	2.7
1998	9	18	12	12	51.6	31.32	36.8	2.8
1998	9	19	12	8	47.9	31.5	36.8	3
1998	9	20	11	42	39.8	31.47	36.68	2.9
1998	9	21	12	10	33.63	31.32	36.78	3.1
1998	9	22	12	8	15.07	31.3	36.84	3.1
1998	9	23	12	9	13.75	31.45	36.61	2.8
1998	9	24	12	11	51.9	30.91	37.34	3
1998	9	25	12	11	48.3	31.38	36.63	3
1998	9	28	12	58	35.2	30.8	37.31	2.7
1998	9	29	12	25	2.82	31.39	36.63	3.1

Year	*Mon*	*Day*	*HH*	Min	Sec	Lat.	Long.	Mag.
1998	10	1	12	21	20.93	31.98	36.13	3
1998	10	2	12	17	47.82	31.68	36.43	3.1
1998	10	4	12	21	34.68	31.24	37.46	3.2
1998	10	5	12	18	40.09	31.62	36.69	3.2
1998	10	14	12	17	24.4	31.57	36.85	2.8
1998	10	18	8	19	40.8	31.74	37.03	2.8
1998	10	22	12	8	26.38	31.59	36.95	2.5
1998	10	23	12	8	51	31.77	36.37	2.8
1998	10	28	12	13	20.13	31.4	36.9	2.9
1998	11	6	12	22	0.62	31.52	36.26	2.8
1998	11	14	11	47	48.77	31.71	36.35	2.8
1998	11	20	12	8	52.93	31.72	36.43	3.3
1998	11	23	12	7	59.84	31.74	36.36	3.2
1998	12	7	12	19	39.85	31.72	36.54	2.8
1998	12	18	12	15	41.24	31.84	36.44	3
1999	1	3	12	14	40.75	31.46	37	2.9
1999	1	4	13	17	50.3	31.46	37.32	2.8
1999	1	8	13	28	51.31	31.98	36.37	2.7
1999	1	10	12	8	50.8	31.62	37.14	2.4
1999	1	11	12	8	23.04	31.55	36.85	2.7
1999	1	12	9	8	40.68	31.68	36.34	2.7
1999	1	12	12	42	9.39	31.46	36.46	2.6
1999	1	13	12	19	6.71	31.56	36.4	2.8
1999	1	22	12	7	43	31.95	36.78	3.2
1999	3	1	12	19	47.37	31.69	36.43	2.5
1999	3	2	12	30	24.66	30.49	37.32	2.6
1999	3	3	13	18	3.8	30.99	37.5	2.5
1999	3	4	16	5	41.57	30.9	37.39	2.7
1999	3	5	13	25	3.07	30.95	37.06	2.5
1999	3	6	12	12	14.85	30.84	37.55	2.9
1999	3	6	12	20	36.93	30.81	37.39	2.5
1999	3	7	12	8	56.34	31.26	37.24	2.9
1999	3	8	12	7	8.08	31.5	37.72	2.6
1999	3	10	9	42	29.73	30.92	37.42	2.5
1999	3	10	13	4	25.5	30.42	37.36	2.5
1999	3	13	11	31	21.54	30.39	38.06	2.5
1999	3	14	12	17	49.32	31.28	36.74	2.7
1999	3	21	12	7	55.19	31.33	36.96	2.8
1999	5	2	12	25	33.43	30.82	37.26	3.3
1999	5	28	15	17	54.7	30.81	37.2	3.5
1999	6	3	12	7	25	30.11	38.04	2.5
1999	6	7	14	35	20	31.53	36.55	2.8
1999	6	11	12	14	26.86	31.83	37.1	3
1999	7	6	11	10	15.1	29.6	39.25	2.9
1999	9	1	9	17	52.9	30.73	37.46	3
1999	9	1	11	19	3.39	31.42	36.87	3.2

Year	*Mon*	*Day*	*HH*	Min	Sec	Lat.	Long.	Mag.
1999	9	1	11	59	23.88	31.26	37.28	3
1999	9	2	11	16	30.71	31.26	37.08	3.2
1999	9	3	10	42	11.39	31.64	36.52	2.9
1999	9	3	11	12	42.26	31.14	38.02	3.4
1999	9	3	11	16	47.14	31.8	36.6	3.3
1999	9	4	10	5	46.3	30.8	37.41	2.9
1999	9	4	11	17	13.49	31.7	36.67	3.3
1999	9	4	14	11	30.55	31.18	36.94	3
1999	9	5	9	31	32.58	31.4	37.68	2.7
1999	9	5	11	15	28.74	31.38	37.29	3
1999	9	6	8	51	18.75	31.49	36.6	3
1999	9	6	13	19	28.3	31.61	37.21	2.8
1999	9	9	12	6	27.75	31.71	37.16	2.8
1999	9	11	11	11	11.07	31.83	36.67	3
1999	9	11	12	38	43.74	30.12	38.89	2.8
1999	9	13	11	13	59.77	31.35	36.94	2.9
1999	9	15	9	25	46.61	31.36	36.77	2.9
1999	9	17	11	42	17.33	31.7	36.75	3
1999	9	25	10	49	56.44	31.79	36.48	2.6
1999	10	3	13	31	38.78	30.9	37.8	3.3
1999	10	5	12	16	27.57	31.49	36.89	3
1999	10	7	12	12	31.1	31.95	36.93	3
1999	10	7	13	3	2.05	31.41	37.21	3.1
1999	10	8	12	11	39.1	31.95	36.93	3.1
1999	10	12	12	13	5.2	31.3	36.7	3
1999	10	19	12	48	24.61	29.9	39.22	2.7
1999	10	20	13	9	56.53	31.37	36.83	2.8
1999	10	25	10	39	43.52	31.5	36.8	2.7
1999	10	25	12	9	38.22	31.7	36.7	2.7
1999	10	26	12	13	24.09	31.9	36.6	2.8
1999	10	27	12	19	22.58	31.41	36.6	2.7
1999	12	2	9	38	54.78	30.44	38.13	2.5
2000	1	15	12	8	23.98	31.19	36.8	2.5
2000	1	17	13	47	32.2	30.55	38.85	2.8
2000	1	21	12	53	49.72	31.49	36.67	2.5
2000	3	1	12	12	19.9	31.88	36.52	3
2000	3	15	12	14	30.85	31.22	36.79	3
2000	3	16	12	11	22.77	31.9	36.6	2.9
2000	3	26	12	7	55.8	31.88	36.45	3
2000	4	7	11	10	25.82	31.87	36.62	2.72
2000	4	13	12	16	50.06	31.14	37.29	2.64
2000	4	18	11	2	13.83	31.67	36.44	2.23
2000	4	20	11	16	14.9	31.52	36.63	2.32
2000	4	21	11	9	57.63	31.8	36.53	2.54
2000	4	22	13	10	52.51	31.43	36.57	2.32
2000	7	4	12	2	59.02	31.81	36.73	2.6

Year	Mon	Day	HH	Min	Sec	Lat.	Long.	Mag.
2000	7	7	11	17	3.06	31.59	36.43	2.8
2000	7	8	11	24	40.99	31.73	36.8	2.7
2000	7	10	11	9	40.52	31.44	36.55	2.9
2000	7	12	11	27	36.35	31.56	36.82	2.6
2000	7	13	12	5	36.27	31.49	36.61	2.7
2000	7	21	11	9	55.05	31.62	36.71	2.7
2000	7	21	11	25	56.38	31.91	36.52	2.5
2000	7	22	13	27	21.72	31.06	37.88	2.7
2000	7	23	11	32	19.54	31.97	36.89	2.6
2000	7	24	12	18	40.13	31.43	36.59	2.7
2000	7	26	12	6	43.63	31.91	36.87	2.8
2000	7	27	11	15	19.64	31.7	36.58	2.7
2000	7	28	11	10	11.62	31.95	36.14	2.6
2000	7	31	11	14	55.82	31.89	37.08	2.6
2000	8	2	11	9	24.42	31.73	36.39	2.9
2000	8	2	12	0	21.73	30.25	37.7	2.98
2000	8	15	11	19	18.73	31.48	36.52	2.8
2000	8	25	11	15	42.6	30.46	37.92	3.26
2000	9	5	11	46	7.22	31.54	36.94	3.07
2000	9	24	11	44	27.89	30.38	36.77	3.13
2000	10	3	12	21	0.35	31.6	36.7	3
2000	10	6	12	13	23.18	31.7	37	3.3
2000	10	7	12	19	22.01	31.6	36.5	2.8
2000	10	10	12	16	49.09	31.6	36.5	2.8
2000	10	17	9	28	9.77	31.2	36.9	2.5
2000	12	7	12	10	14.54	30.19	38.15	3
2000	12	9	14	27	58.79	31.73	36.62	3.1
2000	12	11	12	15	45.65	31.08	37.85	3
2000	12	11	13	5	43.69	31.37	37.15	2.9
2000	12	14	13	21	52.1	31.9	36.6	3
2000	12	14	13	29	2.5	31.5	36.7	2.7
2000	12	20	12	6	15.7	31.9	37.8	3.1
2000	12	20	13	42	46.8	31.4	36.7	2.8
2000	12	21	14	32	19.5	32	36.5	2.9
2000	12	25	12	11	8.1	31.9	36.7	3
2000	12	26	12	29	51.8	31.9	36.6	3.2
2000	12	27	8	11	29.6	30.9	37.1	2.7
2000	12	29	11	3	16.2	31.9	36.2	2.9
2000	12	31	12	7	46	31.9	36.7	3.1
2001	1	4	12	18	23.9	31.7	37.3	3.1
2001	1	10	12	30	6	31.6	36.5	3
2001	1	11	12	6	51	31.9	37.3	3.3
2001	1	12	12	49	57	31.8	37.2	3.3
2001	1	13	12	6	40	31.8	37	3.7
2001	1	14	12	13	29	31.8	37.2	3.5
2001	1	16	12	12	48	31.9	37.3	3.6

Year	*Mon*	*Day*	*HH*	Min	Sec	Lat.	Long.	Mag.
2001	1	19	12	38	15	32	36	3.3
2001	1	23	12	13	22	31.8	37.4	3.6
2001	1	31	12	33	39	32	37.1	3.4
2001	2	4	12	8	27.48	32	36.78	3.22
2001	2	8	10	10	42.39	30.51	37.64	3.47
2001	2	19	10	26	5.7	31.04	37.52	3.13
2001	2	21	12	26	45.72	30.62	37.62	3.45
2001	2	22	9	55	55.6	31.43	38.88	3.38
2001	2	26	6	39	48.6	28.78	39.75	2.75
2001	2	28	12	11	53.3	31.59	36.82	3.01
2001	3	7	8	14	5.94	30.49	37.69	3.06
2001	3	13	12	27	16.8	31.51	36.89	2.78
2001	3	20	12	7	38.44	31.37	37.45	3.02
2001	3	26	12	14	18.19	31.46	37.89	2.91
2001	4	6	12	2	26	30	39.8	3
2001	4	12	12	5	25.3	31.6	36.4	2.8
2001	4	14	11	8	12.69	31.2	38.5	2.9
2001	4	16	11	9	48.8	30.1	39.8	3.4
2001	4	21	12	58	58.4	31	37.8	2.6
2001	6	11	10	40	48.02	31.87	37.09	3.4
2001	6	12	12	11	59.38	31.31	36.69	3.2
2001	6	13	11	4	43.65	31.62	36.89	3
2001	6	26	11	8	38.23	28.34	39.36	3.2
2001	6	28	10	56	59.96	31.64	37.38	3.3
2001	8	8	11	47	46.33	31.49	38.08	3.02
2001	8	9	11	7	43.1	28.8	39.43	2.97
2001	8	22	9	45	38.7	30.6	37.4	3.1
2001	8	29	11	23	17.63	30.15	39.26	3.43
2001	8	29	12	50	35	31.82	37.24	3.63
2001	8	31	11	11	7.53	29.3	39.59	3.43
2001	9	3	11	11	51.97	30.54	38.85	3.39
2001	9	8	11	6	44.47	31.95	36.61	3.06
2001	12	8	11	16	27.08	31.7	36.78	3.18
2001	12	11	12	38	2.53	31.82	37.18	3.43
2001	12	12	12	5	6.76	31.66	36.4	2.6
2001	12	14	11	53	14.96	31.54	36.5	3
2001	12	22	12	10	49.64	31.68	37.01	2.92
2001	12	25	12	22	18.68	31.83	36.35	3.28
2002	1	31	10	47	6	30.9	42.8	3.1
2002	2	5	12	21	21.5	31.6	36.61	3.34
2002	2	7	12	17	38.4	29.17	39.6	3.12
2002	6	26	7	31	35.928	30.4	41.4	3
2002	7	24	9	29	55.58	31.42	36.7	2.6
2002	9	3	11	52	50.482	31.93	36.97	3.1
2002	10	1	11	21	48.6	31.3	36.8	2.9
2002	10	15	12	51	47.8	31.3	37.1	2.9

Year	*Mon*	*Day*	*HH*	Min	Sec	Lat.	Long.	Mag.
2002	10	19	5	0	4.4	30.6	37.7	2.9
2002	12	1	15	6	12.48	31.57	37.39	3.2
2002	12	2	13	14	0.06	31.85	37.02	3.3
2002	12	3	13	16	13.39	31.65	36.94	3.1
2002	12	5	2	21	34.79	29.5	39.49	4
2002	12	16	12	44	51.52	31.43	36.7	2.8
2002	12	17	12	13	25.17	31.49	36.78	2.9
2002	12	18	10	13	16.74	31.52	36.76	3.2
2002	12	23	12	42	47.43	31.9	36.63	3
2002	12	25	12	8	34.69	31.78	37.31	3.2
2002	12	27	12	10	52.89	31.95	37.4	3
2002	12	29	12	47	10.56	31.84	36.75	3.1
2002	12	31	13	10	25.55	31.63	37.21	3
2003	1	18	9	2	1.43	30.6	37.3	2.9
2003	1	19	12	46	25.26	31.6	36.4	2.9
2003	4	9	11	40	0.36	30.8	37.2	3.06

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
15	**Najd Fault Zone**	**28**	**39.5**	**379730**
		20.6	**48.4**	
		17	**45**	
		20.2	**43.1**	
		23.1	**41.5**	

Instrumental Events

YR	MON	DAY	HR	MIN	SEC	lat	long	MAG
1994	6	4	2	13	35	24.52	42.79	3.1
1997	8	17	8	9	8.14	22.17	44.74	4
1997	11	6	12	41	41.1	22.36	43.33	4.4

YR	MON	DAY	HR	MIN	SEC	lat	long	MAG
1997	11	17	21	28	25.93	25.88	41.97	3.4
1997	11	21	11	30	12.23	22.76	43.54	2.8

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
16	**Central Arabian Graben Zone**	**26.4**	**41.4**	**533174**
		31	**46**	
		23.5	**51.5**	
		20.8	**48.4**	

Historical Events (Zone 16)

Year	Mon	Day	HH	Min	Sec	Lat.	Long	Mag
1832	0	0	0	0	0	25.4	49.6	5
1903	9	9	0	0	0	30.4	46.2	5.5

Instrumental Events (Zone 16)

Year	Mon	Day	HH	Min	Sec	Lat.	Long	Mag
1976	9	26	0	12	39.3	29.54	46.76	3.2
1994	3	5	6	33	29	27.2	43.5	3.2
1994	4	10	6	7	24.06	27.16	44.91	2.5
1994	6	11	16	11	10	27.3	42.8	2.9
1994	7	6	5	34	23.27	27.7	44.11	2.5
1994	11	3	4	9	48.6	24.66	49.39	2.8
1995	1	11	10	37	59.25	25.76	49.48	4.1
1995	1	14	7	59	32.26	27.27	48.1	2.6
1995	1	14	7	59	49.44	27.67	47.83	2.7
1995	1	15	6	38	25	27.2	43.11	2.6
1995	2	3	17	28	38.59	29	45.45	4.2
1995	2	11	6	13	34.45	27.62	43.69	3
1995	2	22	5	59	2.58	27.43	44.16	3.5
1995	2	28	17	38	22.79	24.16	49.86	3.7
1995	3	13	6	47	58.5	27.15	44.2	3.7
1995	3	19	5	47	52.12	27.17	44.07	3.3
1995	4	16	5	37	34.58	27.14	44.09	3.6

Year	Mon	Day	HH	Min	Sec	Lat.	Long	Mag
1995	6	1	18	55	29.44	27.29	45.68	5
1995	6	21	4	46	4.85	27.47	44.05	3.6
1995	6	21	15	25	5.09	23.88	50.25	3.2
1995	7	1	5	8	50	27.44	44	2.6
1995	7	15	3	25	4.7	23.96	49.82	3.9
1995	7	26	5	3	53.79	26.18	44	3.1
1995	8	3	4	17	54.87	24.04	50.5	3.5
1995	8	29	4	57	16.74	25.24	44.06	2.9
1995	9	12	5	31	12.8	27.4	44.17	2.8
1995	9	20	7	7	55.6	23.8	45.9	2.6
1995	12	23	0	3	13.87	23.69	50.17	2.1
1996	2	3	5	57	47.2	23.7	50.3	3.8
1996	6	12	5	5	58.91	27	44.08	3.7
1996	7	2	5	17	58.1	27.14	44.04	3.4
1996	8	14	4	39	24.33	27.76	44.28	3.5
1996	8	21	5	21	9.96	26.91	44.21	3.2
1996	9	18	5	10	0.37	27.01	44.23	3.5
1996	9	23	5	18	40.46	27.11	44.16	3.6
1996	10	20	5	17	24.9	27.3	43.9	3.7
1997	2	4	14	44	13.98	24.5	48.89	3.9
1997	2	18	6	56	42.52	27.03	44.28	3.6
1997	3	4	6	30	3.74	27.43	44.31	3.2
1997	4	28	9	10	6.31	24.07	50.87	2.7
1997	5	10	23	51	19.9	23.82	44.03	2.5
1997	6	8	4	53	55.26	27.7	43.83	3.1
1997	6	15	4	52	58.51	26.56	44.92	3
1997	8	2	22	34	0.69	23.49	50.19	3.3
1997	8	4	12	53	7.23	23.67	49.61	3.3
1997	8	5	12	53	9.96	24.04	49.43	3.3
1997	8	20	10	8	58.6	23.79	50.13	2.4
1997	9	28	5	24	29.5	25.33	44.21	3.4
1998	2	18	12	15	37.79	24.36	44.74	3
1998	3	26	13	40	43	24.05	49.36	4
1999	4	3	12	43	28.17	28.89	45.86	2.8
2002	6	1	16	13	45	26.2	46.8	5.3
2002	6	10	11	3	20.211	23.6	50.4	3.6
2002	6	18	21	9	9.77	27.9	48.1	4.2
2002	10	12	5	59	2.3	26.4	44.4	4.1

Zone No.	Name	Coordinates		Area
		Lat. N	Long. E	(KM^2)

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	**Long. E**	
17	**Arabian Gulf**	**31**	**46**	**257798**
		32	**47.2**	
		26	**54.2**	
		23.5	**51.5**	

Historical Events (Zone 17)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
658	0	0	0	0	0	30.5	47.8	5
1786	7	28	0	0	0	30.5	47.8	5
1883	10	16	0	0	0	27.7	52.3	5.9
1929	2	5	1	57	13	31.5	47.5	4.8
1929	10	29	5	53	39	25	51.5	4
1930	8	5	20	30	0	30	48.2	4
1930	8	5	20	30	0	30	48.2	4
1931	7	5	0	0	0	29.9	48.5	4
1934	3	10	0	0	0	26.5	52.5	4
1934	3	18	22	44	31	26.5	52.5	5
1934	3	19	3	28	28	27	52.5	5.2
1936	1	8	12	34	38	27	52.5	4.9
1946	10	23	8	2	5	30	47.5	4.9
1952	8	1	0	0	0	29	50	4
1956	3	1	0	0	0	27	52	4
1956	3	6	0	0	0	26.5	51	5.8
1956	3	6	0	0	0	27.5	52.5	5.3
1957	3	26	4	49	20	27.5	52.25	4
1957	9	3	20	45	30	31	47.5	4
1959	4	19	0	0	0	27.75	51.5	4
1960	1	25	21	34	24	27.5	51	4
1960	3	14	20	14	33	29	49.5	5.5
1960	5	18	8	40	57	27	52.5	4
1960	6	10	13	49	21	26.5	53	5
1960	7	10	22	56	10	26.5	53	5
1962	6	23	5	4	59.2	29.7	49.2	5.6
1963	9	18	22	49	0	26	53	4
1963	9	18	22	49	0	26	53	4

Instrumental Events (Zone 17)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1965	4	26	22	4	37.6	27.3	52.3	4.9
1969	11	7	16	30	29.5	26.59	53.27	5
1969	11	7	13	18	44.4	26.65	53.3	4.6
1969	12	1	13	4	34.1	26.49	53.52	4.7
1970	5	18	6	55	25.7	27.64	52.89	4.7
1973	4	7	10	49	27.2	27.88	52.52	4.3
1973	6	9	20	36	12.3	27.78	52.05	4.7
1976	9	27	2	23	56.6	28.88	48.19	3.8
1977	1	16	20	31	32	29.06	48.04	4
1977	3	31	19	53	15.1	27.7	52.14	4
1977	3	31	13	36	34.7	27.71	52.14	4
1977	3	31	10	6	3.6	27.94	51.98	4
1977	3	31	21	36	0.7	27.94	51.98	4
1983	11	17	9	10	45.3	31.58	47.48	4.7
1994	1	5	0	6	11.5	24.3	50.8	3.5
1994	6	5	15	55	1.35	27.02	49.07	3.5
1994	6	20	9	9	39.46	27.49	50.37	3.8
1994	9	29	0	0	0	27.97	51.86	3.8
1995	1	19	10	6	47.87	29.81	48.12	3.1
1995	7	3	5	59	40.74	27.7	50.58	3.2
1995	7	21	22	52	43.54	29.37	49.31	4
1996	12	14	19	49	56.65	29.28	49.66	3.5
1997	8	13	0	5	0.73	23.96	51.51	3.7
1997	9	8	21	0	44.46	30.9	47.69	4
1997	12	30	18	18	22.1	28.62	48.14	4.6
1998	1	1	13	32	38.54	26.02	51.9	3
1998	7	31	21	19	23.53	27.87	50.84	3
1999	6	11	3	6	9.48	27.62	49.12	4.7
1999	10	31	9	59	33.74	30.8	46.79	2.9
2000	9	13	3	55	9.51	27.81	52.17	5.04
2001	5	24	21	46	32	26.71	53.29	4.5
2002	2	17	13	3	58	28.12	51.75	5.6
2002	2	17	21	18	23	28.17	51.64	4.3
2002	3	9	15	43	23	28.01	51.75	4.7

Zone No.	Name	Coordinates		Area
		Lat. N	Long. E	(KM^2)
18	Zagros Fold Belt	32	47.2	160644
		32	50.2	

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
		27.4	**55.6**	
		26	**54.2**	

Historical Events (Zone 18)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
839	0	0	0	0	0	31.28	48.72	5
840	0	0	0	0	0	31.23	48.67	6.5M_s
978	6	17	0	0	0	27.03	54.03	5
1008	5	0	0	0	0	27.03	54.03	5
1052	0	0	0	0	0	30.5	50.5	5
1085	0	0	0	0	0	30.5	50.5	5
1593	9	0	0	0	0	27.7	54.3	6.3M_s
1677	8	0	0	0	0	27.97	54.12	6.4M_s
1806	0	0	0	0	0	29	50.8	
1824	6	2	0	0	0	29.7	51.5	6.1
1824	6	25	4	50	0	29.75	52.4	6.4M_s
1853	5	5	12	0	0	29.6	52.5	6.2M_s
1858	1	13	0	0	0	29.6	50.5	5.9
1858	12	25	0	0	0	27	55.25	5.5
1862	12	21	10	0	0	29.5	52.5	6.2M_s
1875	3	2	15	0	0	30.5	50.5	5.7
1880	8	0	0	0	0	27	54	5.8
1883	10	16	0	0	0	27.74	52.2	5.8
1890	3	25	0	0	0	28.78	53.65	6.4
1891	12	14	0	0	0	29.9	51.58	5.4
1892	8	15	0	0	0	29.1	52.7	5.4
1907	7	4	9	21	0	27	55	6
1911	1	20	4	5	0	29.3	51.2	5.2
1913	3	24	10	34	11	27.5	53.8	5.5
1924	6	30	0	0	0	27.5	53.8	4
1925	7	30	18	43	16	30	51	5.1
1925	9	24	4	38	39	27.5	55	6.1
1925	12	18	5	53	38	30	51	5.4
1925	12	18	5	53	38	30	51	5.4
1926	4	23	1	31	31	27.5	55	5.3
1927	7	30	0	0	0	28.7	51.9	4
1927	11	16	0	0	0	27.5	53.8	4
1928	4	15	10	9	28	28.7	51.9	5
1928	8	26	0	0	0	28.7	51.9	4
1928	8	27	0	0	0	28.7	51.9	4
1929	7	16	19	43	15	28.7	51.9	5.1

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1929	10	2	0	0	0	28.7	51.9	4
1929	11	20	0	0	0	27.5	55	4
1930	2	15	19	7	5	28.7	51.9	5.2
1930	5	11	22	35	46	27.5	55	4
1930	5	12	0	0	0	27.5	55	4
1930	5	13	0	0	0	27.5	55	4
1930	7	8	0	0	0	28.7	51.9	4
1930	8	17	0	0	0	27.5	55	4
1930	8	23	0	0	0	27.5	55	4
1930	9	2	18	58	48	30	51.5	4
1930	9	2	18	58	48	30	51.5	4
1930	9	5	0	0	0	27.5	55	4
1930	10	18	0	0	0	29.4	51.4	4
1931	7	28	0	0	0	29.5	52	4
1931	8	29	0	0	0	32	49	4
1931	11	16	0	0	0	27.5	55	4
1934	2	4	13	27	14	30.5	51.75	5.5
1934	3	13	0	0	0	30.5	51.7	4
1934	8	31	0	0	0	27.5	53.3	5.5
1935	5	31	13	16	41	31.9	47.8	5.2
1935	10	15	17	2	45	28.7	51.9	5.2
1935	10	27	0	0	0	27.6	54.6	5.5
1936	8	20	2	8	47	30.5	51.7	5.3
1938	4	23	0	0	0	27.3	53.2	4
1939	1	25	11	2	22	31	50	5.4
1939	7	24	0	0	0	27.3	53.2	4
1939	8	18	22	52	35	27	54.5	5
1940	6	1	0	0	0	27	54.5	4
1941	2	4	0	0	0	27.3	53.2	4
1941	3	28	0	0	0	28.3	54.2	4
1941	6	10	20	38	43	32	47.5	4
1941	6	15	12	38	55	27.3	53.2	5.2
1942	6	7	0	0	0	27	54.5	4
1946	3	12	0	0	0	29.8	51.8	4
1946	5	29	0	0	0	30.5	54.5	4
1947	1	2	14	11	8	28.5	51.5	5
1948	7	30	0	0	0	31	49	4
1948	8	5	0	0	0	31	49	4
1949	3	6	0	0	0	29.8	51.8	4
1950	1	19	17	27	16	28	53	5.8
1950	1	22	0	0	0	27.75	53	4
1951	6	9	0	0	0	32	50	5
1951	10	28	0	0	0	27.3	53.2	5.5
1952	8	4	0	0	0	31.3	49.5	4
1952	12	4	0	0	0	27.3	53.2	4
1952	12	23	22	30	0	30.9	49.4	5.1

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1954	1	17	0	0	0	28.5	52.25	4
1954	6	25	0	0	0	30	52	4
1954	11	11	0	0	0	27.25	53.25	4
1955	4	18	19	16	7	28	52.5	5.4
1956	1	3	0	0	0	27	54.5	6.8
1956	2	15	15	49	25	27.5	52.7	5.4
1956	3	9	0	0	0	28	52.75	5
1956	5	19	0	0	0	28	52.75	4
1956	10	31	14	3	38	27.3	54.6	5.5
1956	11	1	5	52	34	27.5	54	5.5
1957	3	2	7	12	10	27.5	53.5	5.5
1957	4	3	0	0	0	27	53.5	4
1957	5	5	0	0	0	31.5	49.5	4
1957	11	18	0	0	0	27.75	54.25	4
1958	3	1	9	26	46	27.5	55	4.8
1958	4	9	4	36	29	29	52	5
1958	6	10	0	0	0	30	50.5	5.4
1958	7	2	0	0	0	30	51.5	4
1958	12	18	0	0	0	27	54	4
1958	12	21	0	0	0	27	54	4
1958	12	25	18	33	28	26.9	54.1	5
1959	1	7	5	13	1	27.4	54.11	5.3
1959	4	29	0	23	45	26.99	54.76	5.4
1959	6	24	16	2	36	31.75	50.25	4
1959	7	18	0	0	0	29.5	51	4
1959	7	24	0	0	0	31	50.5	4
1959	9	19	0	0	0	30	50	4
1959	9	26	0	0	0	27	53	4
1960	2	4	7	7	20	28.5	52.5	4
1960	4	23	6	26	16	31.5	50.5	4
1960	4	24	12	14	26	28	54.5	4
1960	4	27	17	39	32	28	54.5	4
1960	5	2	22	48	32	27.5	54.5	4
1960	5	20	4	14	33	27.5	53	4
1960	5	28	19	42	1	29.8	52.3	4
1960	7	29	16	45	43	27.5	54.5	4
1960	8	1	2	20	50.3	28	54.3	4
1960	9	21	23	5	3.8	31.8	50.5	4
1960	9	25	8	36	27	28.4	53.2	4
1960	11	4	16	53	0	27	54	5.8
1960	11	19	19	25	16	30.5	51.5	4
1961	4	2	12	52	10.6	26.9	55.1	4
1961	4	4	11	39	8.8	30.3	50.5	4
1961	6	6	9	46	18	30.1	52.4	4
1961	6	11	23	13	7.8	28.1	54.7	4
1961	6	11	13	57	58.3	28.2	54.6	4

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1961	6	11	11	24	9.4	27.6	55.3	4
1961	6	11	6	51	29.6	27.7	55.1	4
1961	6	11	9	21	39.4	27.7	55	4
1961	6	11	5	10	26.3	27.8	54.9	4
1961	6	11	5	30	14.5	27.8	55	4
1961	6	11	6	46	57.9	27.8	54.9	4
1961	6	11	8	4	10	27.8	55	4
1961	6	11	10	3	6.3	27.8	54.5	4
1961	6	11	12	31	26.8	27.8	54.4	4
1961	6	11	12	30	23.5	27.8	54.6	4
1961	6	11	15	6	16.7	27.8	54.9	4
1961	6	11	6	10	42.3	27.9	54.6	4
1961	6	12	21	48	30.1	27.1	54.9	4
1961	6	12	17	4	56	27.5	54.3	4
1961	6	12	21	2	38.5	27.5	55.1	4
1961	6	15	6	21	35.6	27.8	54.8	4
1961	6	16	8	45	29.7	27.2	54.5	4
1961	6	18	10	10	8.8	27.3	54.7	4
1961	6	21	19	14	34.9	27.5	54.8	4
1961	6	21	6	39	23	27.8	54.8	4
1961	6	23	16	36	22.8	27.6	55.1	4
1961	6	25	12	40	23.7	27.9	53.7	4
1961	7	5	8	17	53	27.7	54.8	4
1961	7	13	9	28	53	27.4	54.9	4
1961	10	22	22	56	31.8	27.5	54.6	4
1961	10	23	4	40	22.1	27.9	54.5	4
1961	11	5	8	36	31.6	27.8	55	4
1961	11	7	8	39	35.6	27.8	54.5	4
1962	1	20	3	31	24.6	31.2	48.9	4
1962	2	8	20	10	15	31	49	4.4
1962	6	29	22	35	42.3	32	48.8	4
1962	10	1	12	13	57.4	27.9	54.9	4
1962	10	10	20	43	37.3	27.9	54.9	4
1962	11	20	20	45	46.9	27.9	54.9	4
1963	2	4	5	14	31	27.6	54.3	4
1963	2	4	7	18	9.8	27.6	54.3	4
1963	5	29	8	35	3.7	28.1	52.4	6.2
1963	7	13	8	24	24.7	29.6	51	5
1963	7	14	7	46	21.4	29.5	50.8	4
1963	8	10	4	27	33.5	28.1	53.3	4.8
1963	8	12	7	19	54.9	27.7	53.2	5
1963	9	23	18	33	47.4	29.6	50.9	4.7
1963	12	7	9	6	41.3	30.9	51.3	3
1964	1	12	12	45	51.1	31.5	49.4	5.2
1964	1	19	9	13	53.5	26.9	54	5.6
1964	2	16	0	17	15.7	30.1	51.2	5.3

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1964	2	26	9	16	55.2	27.3	54.5	4.6
1964	3	17	12	5	10.2	27	54.1	4
1964	3	21	10	25	32.9	27.1	54.1	4
1964	5	9	7	47	2.4	29.6	52.5	4
1964	7	9	3	38	10.8	29.3	52.7	4
1964	7	22	4	41	55.1	27.6	55	4.9
1964	8	12	2	34	23.7	31	49.8	5.1
1964	8	16	15	52	38.7	27.8	53	4
1964	8	19	15	20	13.9	28.2	52.6	5.6
1964	8	19	9	33	10	28.2	52.7	5.6
1964	8	19	22	40	17.9	28.4	52.7	4
1964	8	20	22	54	48.4	28.1	52.6	5.1
1964	8	20	5	8	50.3	28.2	52.6	5.5
1964	8	20	5	39	47.7	28.7	52.9	4
1964	8	21	7	59	17	28.3	52.5	4.9
1964	9	1	10	40	1.3	30.9	49.9	4
1964	10	18	13	20	20.3	28	54.7	4.8
1964	10	18	22	35	45.5	29.7	50.8	4.9
1964	10	18	21	25	29.9	29.7	51	4.8
1964	10	18	13	20	20.3	28	54.7	4.8
1964	10	19	17	38	44	29.8	51.2	4
1964	11	3	2	25	50.7	29.7	51	4
1964	11	8	10	33	27.5	29.7	51	4.8
1964	11	15	9	33	46.7	29.9	51	5.1
1964	11	17	1	26	26.2	27.5	55	4
1964	12	11	12	40	8.9	28.1	52.8	5
1964	12	11	5	25	58	29	53.2	4
1964	12	18	0	35	19.1	27.8	52.8	4

Instrumental Events (Zone 18)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1965	2	28	8	5	36.5	27.6	55.1	4
1965	4	25	16	39	45	30.4	50.6	4.6
1965	5	4	5	11	48.3	31.7	49.1	4
1965	6	7	13	43	58	30.6	49.5	5
1965	6	18	13	49	36.4	29.8	51.3	4.6
1965	6	24	10	54	0	28.9	52.9	4.2
1965	7	19	8	52	10.6	30.7	50.1	4.2

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1965	9	20	23	23	22.7	30.5	50.1	4.6
1965	9	21	15	46	0.4	27.4	55.3	4.2
1965	11	10	10	3	32.6	27.2	54.5	4.3
1965	12	13	5	7	17.1	30.9	51.1	4.9
1965	12	23	11	10	1.3	27.7	54.6	4.8
1966	1	16	20	2	7	30.8	50.3	4.4
1966	2	26	20	50	37.3	30.5	50.8	4.7
1966	6	9	22	24	43.6	27.6	52.7	5.1
1966	7	29	8	20	46.2	28.5	51.7	4.8
1966	9	2	11	12	59.1	27.7	52.4	4.9
1966	9	18	11	58	28.4	27.9	54.3	5.9
1966	9	24	10	0	46.5	27.4	54.6	5.3
1966	9	29	17	44	33.5	27.8	54.3	5.1
1966	12	2	3	7	50.7	28.2	53.6	4.9
1967	1	2	13	50	7.1	30.63	50.44	5.2
1967	1	9	1	55	15	27.64	54.48	5.3
1967	1	12	18	14	22	28.02	54.44	4.8
1967	1	15	0	3	14.3	29.76	51.47	4.7
1967	2	11	15	18	6.4	30.5	50.67	5
1967	2	12	16	46	4.3	30.32	50.29	4.8
1967	2	21	15	10	26.6	31.69	49.05	4.9
1967	3	3	7	36	28.8	30.25	50.4	4
1967	3	15	16	25	56.8	30.05	50.46	5
1967	4	6	12	57	14.4	29.89	51.01	5.2
1967	4	30	8	9	18.8	31.81	49.81	4.5
1967	5	20	21	48	52.5	29.66	52.19	4.8
1967	5	23	16	59	38.6	30.99	50.38	4.7
1967	7	10	10	57	54	28.2	53.6	4.4
1967	7	27	1	40	53.6	31.7	50.8	5
1967	11	15	19	35	46.3	30.7	51.4	4.6
1968	1	2	11	59	32	29.4	52.6	5
1968	3	26	4	42	19.6	29.6	51.4	4.9
1968	5	30	19	53	6	29.75	51.25	5.2
1968	5	30	1	10	30	27.83	54.01	5.2
1968	6	13	23	4	0.3	29.74	51.46	5
1968	6	15	0	8	24	29.59	51.64	4.5
1968	6	22	15	56	46.6	29.63	51.48	4.8
1968	6	23	9	16	18.6	29.81	51.16	5.2
1968	6	26	1	54	15.3	29.84	51.08	4.9
1968	7	1	23	42	21	29.86	51.55	4.7
1968	7	8	17	15	28.3	29.75	51.11	4.9
1968	7	12	10	34	3.1	29.76	50.64	4.8
1968	7	21	17	0	32	30.09	50.85	4

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1968	9	14	19	20	22.7	28.36	53.15	5.1
1968	9	14	13	48	31.2	28.44	53.11	5.8
1968	9	15	6	14	58.7	28.33	53.2	4.5
1968	9	19	22	12	38.2	28.26	53.12	4.8
1968	9	19	23	35	56	28.35	53.23	5.1
1968	10	9	18	6	3.9	29.92	53.84	4
1968	11	6	17	6	5.3	31.74	50.68	4.6
1969	2	8	23	23	34.9	29.88	50.95	5.1
1969	3	12	17	43	34.1	28.25	53.08	4.5
1969	4	14	13	13	21.8	27.78	54.67	5
1969	4	29	4	37	40.7	29.57	51.48	5.6
1969	7	1	6	0	55.3	28.21	55.41	4.8
1969	9	1	23	16	16	30.88	49.77	4.9
1969	11	3	21	53	16.1	26.71	53.67	5
1969	11	5	19	2	18.1	26.51	53.62	4
1969	11	6	4	36	0.7	26.35	53.66	5
1969	11	7	15	16	4.4	26.55	53.73	5
1969	11	8	0	38	48.3	26.68	53.73	4
1969	11	15	23	58	52.1	26.77	53.55	4.9
1970	1	20	11	0	13.1	30.65	51.38	4.9
1970	2	23	11	22	26.2	27.82	54.53	5.5
1970	3	21	13	23	14.4	27.85	54.57	4.6
1970	5	11	3	12	19.7	28.54	52.27	5.1
1970	6	16	17	25	2.1	29.57	51.34	4.3
1970	7	12	1	16	9.1	30.36	51.66	4
1970	7	21	10	39	14.2	29.3	52.19	4.5
1970	8	20	15	29	52.2	29.28	51.62	4.4
1970	10	18	6	10	39.1	27.34	55.05	4.8
1971	4	6	6	49	52.9	29.8	51.89	5.2
1971	5	25	6	52	48.9	27.3	53.38	4.8
1971	5	25	4	32	36.9	27.7	55.39	5.1
1971	6	2	10	5	9.3	29.39	51.58	4.8
1971	6	28	21	33	11.6	26.88	54.91	4.1
1971	8	22	17	54	14.6	30.08	50.73	5.1
1971	8	25	0	30	44.5	28.17	52.27	4.1
1971	8	26	6	55	8.7	29.99	50.72	4.8
1971	8	27	5	20	15.1	30.15	50.73	4.4
1971	8	27	7	59	11.2	30.17	50.74	5
1971	9	2	22	21	39	30.08	50.76	5
1971	9	2	18	24	47.3	30.1	50.78	5.1
1971	9	2	12	24	22.8	30.5	50.29	4.8
1971	9	4	13	42	19.5	30.08	50.86	4.6
1971	10	23	11	49	20.6	29.59	51.32	4.5

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1971	11	8	3	6	36.4	26.9	54.46	4.9
1971	11	8	3	24	26.6	27.05	54.48	5.6
1971	11	9	0	16	58.2	26.99	54.52	4.8
1971	12	15	15	24	57.4	30.25	50.57	4.9
1971	12	29	21	12	37.3	29.55	52.85	4.9
1972	1	6	9	41	33.2	30.3	50.52	5.2
1972	2	8	19	54	55.4	29.65	50.96	4.3
1972	2	9	14	21	51.2	29.44	50.78	4.3
1972	2	10	9	4	9.2	29.54	50.93	4.1
1972	2	10	6	49	15.9	29.56	50.87	3.9
1972	2	10	16	40	16.2	29.69	50.89	4.5
1972	2	28	16	44	57.9	29.54	50.67	4.4
1972	2	28	18	44	54.2	29.79	50.65	4.7
1972	4	3	9	7	16	28.51	52.64	4.7
1972	4	10	20	27	7.5	28.01	53.16	3.9
1972	4	10	2	34	31.5	28.19	52.91	4.1
1972	4	10	9	3	56.5	28.25	53.08	4.6
1972	4	10	10	46	58.8	28.28	53.08	4.6
1972	4	10	2	6	53.2	28.3	52.98	4.6
1972	4	10	4	36	15.5	28.37	52.9	4.7
1972	4	10	9	46	45.8	28.4	52.59	3.9
1972	4	10	8	33	51.8	28.42	52.91	4.9
1972	4	10	14	35	34.3	28.43	52.83	6.1
1972	4	10	3	37	57.3	28.5	52.48	4.1
1972	4	12	23	7	49.9	28.28	53.12	4.3
1972	4	12	5	51	38.9	28.32	53.09	5.1
1972	4	12	22	31	48.7	28.38	53.04	5
1972	4	12	18	37	40.8	28.41	53.04	4.3
1972	4	13	18	37	10.3	28.26	53	4.5
1972	4	16	23	44	31.6	28.29	52.73	4.3
1972	4	17	21	11	22.4	28.33	52.94	4.5
1972	4	21	14	33	9.4	28.49	52.4	4.1
1972	4	23	2	0	6.9	28.19	53.19	4.2
1972	4	23	22	28	15.2	28.7	53.19	4.6
1972	4	24	14	41	9.3	28.47	53	4.6
1972	4	25	13	21	14.8	28.36	53.18	5
1972	4	29	16	4	21.1	28.29	52.97	4.9
1972	5	4	4	59	24.4	28.34	52.42	4
1972	5	16	10	59	52.6	28.35	52.62	5
1972	5	20	6	44	26.1	28.34	52.79	4.9
1972	5	25	9	4	26.2	28.27	53.06	4
1972	6	6	17	54	43.3	26.86	53.37	4.9
1972	7	2	12	56	6.7	30.04	50.83	4.6

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1972	7	2	14	5	6	30.11	50.85	5.4
1972	7	3	21	38	22.2	30.05	50.99	5.1
1972	7	3	2	10	0.4	30.11	50.79	5
1972	7	14	13	4	11.8	30.08	50.85	4.4
1972	8	5	4	8	13.7	28.24	52.95	4.3
1972	8	6	8	42	33.2	31.75	50.14	5
1972	9	9	1	42	29	28.5	52.67	5.1
1972	10	9	1	58	7.3	30.25	50.86	4.1
1972	10	9	8	29	49.3	29.62	52.42	4.4
1972	11	25	22	43	29.5	28.42	53.74	4.7
1972	12	26	18	35	22.9	28.4	52.73	4.6
1973	2	24	0	2	40.1	28.58	52.62	5.2
1973	3	3	2	46	25.3	29.52	51.15	4.6
1973	3	12	15	39	58.1	31.88	49.14	4.5
1973	3	19	22	13	9.7	26.78	53.43	4.5
1973	3	28	3	36	38.2	28.57	52.67	5.2
1973	4	5	1	59	12.6	30.92	50.53	5
1973	4	19	23	4	34.5	28.25	53.48	4.4
1973	4	22	21	29	57.2	30.74	49.83	5
1973	5	3	7	44	24.4	28.2	51.9	4.6
1973	6	2	13	42	9.1	26.95	53.43	3.9
1973	6	9	20	38	42.3	28.09	52.08	4.5
1973	6	25	10	29	2.6	30	50.46	5
1973	7	22	9	47	49.6	31.34	49.61	3.3
1973	8	5	9	44	52.3	31.06	50	4.6
1973	8	6	5	31	45	31.08	49.87	4.5
1973	8	15	4	35	42.9	30.92	49.97	4.1
1973	8	24	9	34	10.5	28.01	52.94	4.9
1973	8	24	2	12	41.1	27.83	52.73	5.1
1973	8	24	2	6	1.6	27.9	52.71	4.9
1973	9	23	3	43	12.4	30.72	49.25	4.2
1973	12	16	8	25	0.4	28.47	52.6	4.9
1974	3	1	6	14	52.3	30.78	50.07	4.4
1974	3	11	20	21	34.5	28.46	52.78	4.7
1974	4	11	21	2	20.9	29.72	51.56	3.8
1974	4	23	19	27	33.5	26.84	54.59	4.4
1974	6	18	0	6	29	29.82	51.7	4.3
1974	8	2	8	23	44	30.46	50.59	4.8
1974	8	5	13	19	39.5	27.98	53.55	5.3
1974	10	17	4	10	15.8	30.89	49.58	4.6
1974	12	26	18	36	21.9	29.5	52.73	4.8
1975	1	10	14	19	18.7	29.29	51.37	4.2
1975	1	11	12	8	6.4	30.17	50.4	4.1

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1975	1	11	10	14	31.4	30.2	50.44	4.1
1975	1	11	10	4	43.8	29.04	51.85	5
1975	1	12	4	12	41.9	28.93	51.96	4.6
1975	1	29	23	1	8	27.31	53.84	4.1
1975	2	26	17	19	37	27.87	52.76	4.6
1975	2	27	13	9	16	28.14	52.96	4.2
1975	4	24	5	30	25.5	29.53	50.61	4
1975	5	9	18	0	22.9	30.2	52	4.9
1975	5	9	18	1	45.6	29.91	51.95	4.5
1975	6	2	4	21	57.1	30.01	52.1	4.1
1975	6	2	4	21	57.1	30.01	52.11	4.1
1975	6	13	10	12	49.8	27.01	54.94	4.9
1975	6	20	9	16	46.5	26.19	54.3	4.7
1975	8	22	6	12	41.3	27.43	52.66	4.1
1975	9	22	11	52	46.8	27.94	53.91	4.7
1975	10	22	4	41	43.9	31.64	50.22	3.6
1975	11	18	23	7	53.3	31.43	49.87	4.3
1975	11	18	11	44	51.6	28.94	52.95	4.3
1976	1	16	5	36	18.1	30.22	50.84	4.9
1976	1	27	7	59	57.4	30.4	50.57	4.1
1976	1	29	20	2	53.4	30.39	50.72	3.7
1976	2	15	5	47	27.6	31.99	49.02	4.4
1976	2	20	13	37	50.7	30.59	50.32	4.7
1976	2	21	19	14	28.5	29.39	51.39	3.7
1976	2	26	9	22	46.9	31.4	50.09	4
1976	3	16	7	28	57.6	27.31	55.06	5.4
1976	3	18	5	56	7.5	27.29	55.05	4.4
1976	3	20	9	24	0.2	27.27	55	4.7
1976	3	22	2	42	45	26.75	55.11	3.9
1976	4	5	16	21	16.5	28.1	51.98	4.2
1976	4	13	22	0	55.3	31.49	50.3	3.8
1976	4	22	17	3	7.9	28.71	52.13	6
1976	4	23	3	14	20.4	31.35	49.97	4.3
1976	4	26	4	57	25.5	28.72	52.08	5.2
1976	5	2	16	57	5.3	28.19	53.29	4.6
1976	6	2	18	4	40.5	28.13	53.33	5
1976	6	27	9	26	31.9	29.48	52.1	4.7
1976	6	28	17	0	54.9	29.46	52.04	4.6
1976	7	17	8	36	58.5	29.67	51.47	4.7
1976	8	10	21	12	9.7	30.75	50.59	4.5
1976	9	5	16	43	15.8	31.43	49.97	5.1
1976	9	6	16	4	45.1	31.13	50.37	5
1976	9	10	11	55	16.4	31.57	49.78	4

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1976	9	14	23	41	26.4	28	53.52	5
1976	9	14	23	41	26.4	28	53.52	5
1976	9	16	17	57	27	27.91	53.55	3.9
1976	10	12	1	26	0	27.14	53.43	2.5
1976	10	15	23	3	26.1	30.04	51.97	5.1
1976	10	18	10	20	12	30.08	52	5.1
1976	10	23	7	5	59.1	29.93	51.84	4.3
1976	12	1	5	3	37.7	26.99	54.9	4.7
1977	1	7	7	15	57.5	30.7	50.69	4.6
1977	1	29	23	40	1.3	28.52	53.35	3
1977	2	14	5	30	23.6	27.29	52.9	4.6
1977	2	19	17	37	26.9	27.35	53.07	4.6
1977	3	16	13	19	0	30.52	50.81	4.2
1977	3	22	2	26	5.1	29.52	51.47	4.2
1977	3	26	14	28	6	31.3	50.02	4
1977	3	27	11	59	53.3	31.37	50.01	4.4
1977	3	31	21	36	32.6	31.1	50.9	4
1977	4	9	17	34	5.9	27.98	52.04	4.9
1977	5	19	22	58	30.8	29.79	51.2	5.2
1977	5	19	23	45	53.6	27.12	55.32	5.3
1977	5	19	0	8	15.5	27.14	55.31	4.9
1977	5	20	17	37	38.9	27.08	55.11	4.6
1977	5	26	16	43	37.9	29.75	51.1	4.9
1977	6	2	3	57	2.6	29.39	53.21	4.7
1977	6	6	18	39	47.4	29.71	51.13	4.9
1977	7	14	15	23	57.3	26.97	53.5	4.3
1977	8	28	23	50	32.3	27.98	54.92	4.7
1977	9	16	7	5	7.4	30.06	51.46	4.4
1977	9	19	0	23	6	29.63	51.35	4.7
1977	10	19	6	35	10.9	27.79	54.88	5.6
1977	10	27	0	22	22	29.74	50.69	4.8
1978	1	5	19	30	21.3	27.59	53.85	4.7
1978	1	6	5	27	10.9	27.68	53.83	4.3
1978	1	8	2	55	48	30.16	50.86	4.8
1978	1	15	7	3	18.6	30.23	50.6	4.7
1978	3	23	11	14	29.6	27.27	53.25	4.6
1978	3	30	1	23	24.3	30.78	49.61	2.5
1978	5	4	16	18	39.2	27.91	54.84	4.5
1978	5	11	9	55	40.7	28.12	54.1	4.5
1978	7	8	7	11	22	29.24	51.3	4.3
1978	7	28	21	48	11.3	31.99	49.43	4
1978	7	28	19	32	44.4	29.39	52.15	3.7
1978	8	29	14	11	4.3	29.56	51.57	4.9

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1978	8	31	20	24	2.3	29.42	51.5	4.4
1978	10	12	6	54	31.3	27.28	52.81	4.2
1978	10	12	3	5	44.4	27.78	54.9	4.7
1978	11	30	20	59	34.4	30.58	50.69	4.5
1979	2	11	22	25	12.9	27.9	54.84	4.7
1979	3	21	21	3	16	31.56	49.55	4.2
1979	3	28	1	33	26.9	30.9	49.93	5.1
1979	4	8	18	27	13.9	29.6	51.39	4.2
1979	5	15	0	29	5.8	28.38	51.42	4.5
1979	5	26	7	3	54.8	29.68	50.26	4.3
1979	6	1	23	38	38.3	27.38	55.13	4.5
1979	6	14	20	53	56.3	26.65	54.83	4.4
1979	6	26	15	54	17.5	31.27	49.52	4.5
1979	8	19	12	23	15.4	30.38	50.87	4.9
1979	9	17	17	19	33.5	29.64	52.46	4.4
1979	9	21	8	59	47.5	29.32	52.31	4.4
1979	9	30	18	28	13.3	28.26	51.89	4.1
1979	9	30	20	42	27.7	27.82	54.73	4.8
1979	11	25	1	7	8	26.32	54.29	4.5
1979	12	24	19	54	46.6	29.1	52.06	4.7
1980	1	11	16	52	54.8	26.38	54.22	4.4
1980	2	6	12	56	4	26.76	53.84	5
1980	2	7	21	18	39.1	28.06	53.32	4.8
1980	2	26	17	37	13.5	27.37	53.36	4.6
1980	2	26	15	53	6	27.53	53.48	4.7
1980	3	4	17	23	6.5	29.62	52.05	4.3
1980	6	4	0	32	49.8	27.25	55.11	4.5
1980	7	13	21	17	52.9	29.57	51.92	4.6
1980	7	16	8	53	48.4	29.49	51.9	4.8
1980	8	22	12	58	36.2	27.22	54.75	4.8
1980	10	15	13	27	19	29.36	51.71	4.9
1980	10	22	4	52	47.7	30.22	50.73	4.7
1980	11	21	12	43	25.1	28.21	52.16	4.6
1980	12	27	22	7	9.4	30.74	50.61	4.3
1981	1	28	4	27	11.3	27.63	53.48	4.5
1981	3	21	6	18	30.6	28.09	53.14	5.1
1981	4	1	10	16	59.2	29.85	51.5	5.4
1981	4	18	13	35	44.8	29.26	52.02	4.2
1981	5	20	23	38	20.5	28.24	51.78	4.6
1981	6	30	3	18	2.24	27.06	55.24	4.7
1981	9	3	17	5	6.76	27.62	55.31	4.9
1981	9	6	5	32	43.27	28.19	52.82	4.2
1981	9	13	1	43	26.2	27.4	53.88	4.4

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1981	11	22	17	22	52.15	27.56	54.95	4.6
1981	11	28	6	42	39.56	30.87	50.6	4.6
1982	1	1	21	54	30.28	30.29	50.77	4.9
1982	1	7	22	28	39.01	30.28	50.78	4.6
1982	1	16	11	24	30.88	30.23	50.84	4.5
1982	2	5	16	28	56.6	32	49.62	4.7
1982	2	13	18	35	3.9	29.13	51.32	4.1
1982	2	20	21	24	36.06	30.55	50.37	4.7
1982	4	17	2	42	4	28.64	51.72	4.4
1982	7	13	14	15	39.27	30.59	49.17	4.1
1982	7	15	6	49	8.9	29.84	50.67	4.9
1982	10	5	8	47	21.03	27.62	53.31	4.5
1982	10	21	23	13	57.47	28.48	52.12	4.9
1983	4	15	6	18	45.94	30.64	50.23	4.7
1983	6	1	19	2	25.92	28.1	53.7	4.2
1983	6	1	20	0	26.91	29.05	51.41	4.3
1983	7	11	20	34	10.81	29.15	51.878	4.6
1983	8	13	17	18	36.57	28.28	53.28	4.8
1983	9	23	11	23	20.2	30.75	50.29	3.9
1983	12	22	19	49	53.29	31.33	48.77	4.4
1984	3	2	1	51	32.9	27	53.7	4.6
1984	6	2	15	22	38.88	31.52	50.52	4.4
1984	6	22	15	39	22.32	31.19	49.78	4.7
1984	9	19	16	57	16.69	29.93	50.43	4.6
1984	12	22	16	5	12.85	27.85	54.44	5.1
1984	12	29	10	57	1.5	27.43	54.36	4.4
1985	2	2	22	40	9.05	28.39	52.87	4.6
1985	2	2	20	52	34.29	28.39	52.99	5.2
1985	2	2	22	21	29.74	28.83	52.96	4.5
1985	2	7	12	1	44.5	29.88	50.22	4
1985	3	27	2	6	42.75	31.66	49.96	5.2
1985	4	19	23	59	13.69	28.3	53.65	4.6
1985	4	30	12	5	4.9	31.55	49.85	4.5
1985	5	19	0	55	11.05	29.74	51.13	4.7
1985	5	31	13	19	19.13	30.08	51.66	4.7
1985	7	4	6	4	46.02	29.41	52.64	4.8
1985	7	23	23	51	42.28	30.35	50.58	4.9
1985	7	31	18	9	41.87	28.93	52.34	5
1985	8	10	13	29	52.63	28.01	53.46	4.6
1985	8	19	12	47	49.95	29.15	52.29	4.4
1985	9	16	20	37	34.97	31.28	49.47	4.4
1985	9	18	0	10	34.88	31.63	49.45	5.2
1994	1	4	7	21	1.6	29.19	51.44	4.8

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1994	1	15	21	18	40	31.6	49.03	4
1994	1	17	9	47	28	31.42	49.49	4.1
1994	3	1	5	43	36	28.63	52.26	4.4
1994	3	1	3	49	52	28.94	52.86	4.4
1994	3	1	19	3	4.3	29.01	52.61	4.5
1994	3	1	3	49	15.3	29.1	52.62	5.8
1994	3	3	23	53	32	28.9	52.47	4.9
1994	3	7	0	57	32	29.03	52.73	4.2
1994	3	17	8	6	38	28.94	52.54	4.8
1994	3	18	3	51	35	29.04	52.49	4.4
1994	3	19	4	54	10	28.63	53.13	4.4
1994	3	19	5	58	2	28.73	52.59	4.4
1994	3	23	17	47	30	28.87	52.6	4.7
1994	3	29	0	0	0	29.1	51.26	5.4
1994	3	30	7	57	10	28.99	52.75	5.5
1994	4	1	14	25	32	28.82	52.65	4.6
1994	4	3	6	52	38	28.82	52.75	5.2
1994	4	3	0	0	0	28.89	52.71	4.7
1994	4	6	7	10	35	28.65	51.65	4.9
1994	4	14	0	0	0	29.16	51.59	4.5
1994	4	19	0	0	0	31.43	49.54	4.8
1994	4	21	11	51	4	27.48	54.39	4.6
1994	4	26	0	0	0	31	50.64	4.5
1994	4	30	23	12	5.8	29.01	52.69	4.1
1994	5	7	14	24	50	30.33	50.59	4.7
1994	5	25	0	0	0	29.07	52.4	4.3
1994	6	5	16	54	36	29.6	52.31	4.5
1994	6	11	0	0	0	29.07	52.54	4.8
1994	6	13	0	0	0	29.16	52.63	4.2
1994	6	14	0	0	0	27.6	54.34	4.1
1994	6	18	12	42	13.88	28.69	53.14	3.3
1994	6	18	0	0	0	28.97	52.67	5.1
1994	6	20	0	0	0	28.97	52.61	5.9
1994	6	20	0	0	0	29.13	52.39	4.5
1994	6	21	0	0	0	29.02	52.6	4.7
1994	6	21	0	0	0	29.15	52.55	4.4
1994	6	22	0	0	0	28.75	53.05	4.3
1994	6	24	0	0	0	30.25	52.01	4
1994	7	13	0	0	0	29.88	51.2	4.5
1994	7	26	0	0	0	28.48	52.12	4.2
1994	7	31	0	0	0	31.89	49.22	4.4
1994	8	6	0	0	0	26.99	54.36	5.3
1994	8	7	0	0	0	27.11	54.47	4.7

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1994	8	10	0	0	0	26.95	54.35	4.8
1994	8	11	0	0	0	27.04	54.47	5.2
1994	9	5	0	0	0	29.42	51.28	5
1994	9	20	0	0	0	29.01	51.73	3.8
1994	9	27	0	0	0	31.66	49.18	4.5
1994	10	27	0	0	0	31.43	49.41	4.6
1994	11	3	0	0	0	28.26	52.2	4.9
1994	12	7	0	0	0	30.97	51.05	4.9
1994	12	8	0	0	0	29.68	52.8	5
1994	12	13	0	0	0	27.27	54.92	4.8
1994	12	15	0	0	0	29.02	52.62	4.7
1995	1	1	8	51	18.11	30.32	50.29	5.6
1995	1	1	8	51	18.11	30.32	50.29	3
1995	1	9	22	44	25.53	27.22	54.46	3
1995	1	25	19	24	15.69	28.91	52.04	3.8
1995	1	27	21	8	41.19	30.34	51.19	4.2
1995	2	4	14	30	53.71	31.01	51.05	4.3
1995	2	15	13	5	14.46	29.79	52.09	4.5
1995	3	22	6	29	10.2	30.19	51.07	4.7
1995	4	3	12	3	15	29.64	51.05	4.3
1995	4	18	6	12	43.85	31.6	49.21	4
1995	4	18	23	41	12	31.81	49.28	4.7
1995	4	22	0	21	50.5	30.91	49.84	5.4
1995	5	3	2	50	5	28.44	52.74	4.7
1995	5	25	9	22	12	28.23	52.39	4.2
1995	5	27	8	34	37.1	30.54	50.78	4.6
1995	5	31	20	44	10	28.19	53.26	5
1995	7	10	1	54	57.11	30.89	49.97	4.7
1995	7	21	1	48	37.6	31.77	49.3	4
1995	10	14	16	22	23	27.35	54.69	4.8
1996	12	15	19	49	44.3	29.05	50.51	4.3
1997	5	5	15	47	52.91	29.2	51.6	4
1997	7	30	5	4	34.74	30	51.1	4
1997	8	1	20	7	16.9	28.94	53.35	4.2
1997	8	29	14	43	50	27.18	54.31	5.4
1997	10	3	11	29	14	27.74	55.15	4.4
1997	11	30	12	7	22.33	29.85	51.53	2.8
1998	1	11	8	8	1.05	30.68	51.12	4.5
1998	1	11	19	39	12.95	29.05	51.91	4.5
1998	3	18	17	29	53.07	28.09	53.14	3.6
1998	3	18	5	36	53	27.09	54.97	3.8
1998	6	13	2	23	41.86	27.92	54.2	4.1
1998	7	19	19	57	8.77	29.72	51.53	3

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1998	9	2	20	17	10.04	28.94	53.1	3.9
1998	9	5	0	42	34.81	28.78	52.83	4.2
1998	10	1	4	50	47.7	30.12	52.3	4.4
1998	11	8	19	50	36.31	30.22	51.69	4.1
1999	5	6	23	1	0.16	29.31	52.04	5.6
1999	5	30	0	15	50.97	29.54	50.69	4.5
1999	9	17	20	17	43.18	29.33	53.07	4.6
1999	9	24	19	17	15.26	28.73	51.64	4.8
1999	9	25	19	19	29.04	29.04	51.84	4.9
2000	3	13	23	16	16.4	29.52	51.9	4.3
2000	6	23	6	15	13.21	30.25	52.04	4.2
2001	2	22	3	20	9	29.43	51.24	4.7
2001	3	28	16	34	22.32	30.12	51.51	5.1
2001	4	13	1	4	22	27.77	55.14	5.1
2001	6	9	4	45	40	29.42	51.76	4.6
2001	9	2	13	34	16	30.5	50.73	4.4
2001	9	24	22	3	20	30.35	52.02	4.2
2001	10	16	13	1	2	30.06	50.71	4.6
2001	11	2	22	5	28	27.05	54.57	5.2
2001	11	4	16	38	9	27.12	54.61	4.9
2001	11	17	12	14	46	30.54	50.78	4.8
2001	12	23	23	33	40	31.71	49.28	5
2002	3	4	5	26	56	26.57	53.78	4.5
2002	3	10	19	43	35	27.69	54.36	4.4
2002	4	4	20	32	13	28	52.72	4
2002	4	8	16	34	4.6	27.11	55.23	4.8
2002	4	15	3	6	34	26.65	53.87	4.2
2002	5	8	1	7	1.5	27.34	53.68	4.5
2002	5	9	19	33	12	30.24	50.87	4.5
2002	5	16	11	0	12	29.68	51.79	4.5
2002	5	17	15	52	22	29.41	51.98	4.8
2002	6	3	13	35	26	29.46	52.13	4.5
2002	6	7	11	1	1.153	30.6	50	2.8
2002	6	16	22	30	21	29.77	50.91	4.5
2002	6	18	22	51	56	28.26	54.4	4.3
2002	6	19	15	48	25	27.31	54.03	4.8
2002	8	22	6	7	31	29.02	50.9	4.4
2002	9	9	7	56	51	29.42	51.5	4.5

Zone No.	**Name**	**Coordinates**		**Area**
		Lat. N	**Long. E**	**(KM^2)**

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
19	**Sanandaj-Sirjan Ranges**	**32**	**50.2**	**148636**
		32	**53.8**	
		28.8	**57.3**	
		27.4	**55.6**	

Historical Events (Zone 19)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1923	9	22	20	47	38	29	56.5	5.5
1923	9	23	0	0	0	29.5	56	4
1924	1	18	0	0	0	29.5	56	4
1927	7	24	0	0	0	28.5	56	4
1929	1	21	0	0	0	30.5	54.5	5.5
1929	8	11	0	0	0	30.5	54.5	4
1930	4	15	9	56	27	29	54	4
1931	5	3	0	0	0	30.5	54.5	4
1931	9	2	0	0	0	30.5	54.5	5
1936	4	17	0	0	0	28	55.7	5.5
1936	11	6	0	0	0	28.5	56.8	5.5
1939	11	4	10	15	24	31	51.5	4
1949	12	16	0	0	0	27	54.5	4
1951	8	16	0	0	0	28	56	5.7
1954	4	6	8	12	48	28.75	55	4
1954	5	18	0	0	0	30.5	53.25	4
1954	5	20	0	0	0	30.5	53.25	4
1956	7	16	0	0	0	28.5	54.5	5.5
1957	10	11	0	0	0	31	55	4
1958	5	2	21	20	13	28.5	55	5.5
1958	7	26	0	0	0	31	52	4
1960	1	26	0	0	0	28.5	56	4
1960	3	2	0	0	0	32	50.25	4
1960	3	24	0	0	0	31.5	51	4
1960	5	3	6	59	4	29.5	55	4
1960	7	31	22	26	49	28	55	4
1961	6	5	3	30	56	28.5	54.9	4
1961	6	5	6	11	32.9	27.9	55.1	4
1961	6	14	9	3	37	27.9	55	4
1961	6	17	8	5	53	27.9	55	4
1961	6	18	14	51	32.1	28	54.9	4
1961	6	18	10	52	3	27.8	55.2	4
1961	6	20	3	21	34.4	28.9	54.7	5.3

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1961	6	22	9	5	15.1	28	54.9	4
1961	7	9	8	5	45.9	29	54.7	4
1961	7	17	5	13	21.3	27.8	55.1	4
1961	9	27	8	21	59.6	28.5	54.7	4
1962	3	15	15	1	40	28.4	51.6	4
1962	7	3	6	31	8.5	28	56.2	4
1962	8	14	7	27	44.8	28	55.6	4
1962	9	19	7	28	43.2	29.9	54.6	4
1962	11	6	0	9	47.7	28	55.6	4
1962	11	10	1	32	2.9	27.9	55.5	4
1963	2	13	1	34	38.5	27.7	55.4	3.9
1963	4	24	23	22	20.8	28.2	55.9	5
1963	5	2	1	58	25.5	28.5	54.9	5.9
1963	5	3	10	44	29.6	30.7	51.8	5.3
1963	7	29	0	0	0	27.8	55.6	5.2
1963	9	22	10	40	55.8	29.3	55.3	4.7
1964	2	14	15	51	12.1	29.2	54.5	4.7
1964	3	20	3	15	45.6	28.2	55	5.8
1964	8	27	12	56	46.1	28.2	55.7	5.1
1964	9	14	15	21	9	28	55.8	4.8
1964	9	14	15	21	9	28	55.8	4.8
1964	10	31	14	59	35.6	27.7	55.7	4

Instrumental Events (Zone 19)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1965	6	21	1	30	38.9	28.1	55.9	6
1965	6	21	0	21	16.1	28.4	55.8	5
1967	1	8	1	43	47.1	27.75	55.67	4.6
1967	7	25	13	0	38.8	28.9	54.5	4.5
1967	8	2	13	55	14.3	30.9	53.5	4.5
1967	11	21	15	4	54.7	30.8	50.4	4.6
1970	6	30	15	35	32	31.41	53.74	4
1971	4	12	19	3	25.9	28.31	55.6	6
1971	4	13	20	43	0.3	28.16	55.63	4.8
1971	5	7	23	18	45.3	28.26	55.46	4.5
1971	5	31	11	5	55.9	28.9	54.57	4.4
1971	10	5	18	31	17.7	31.57	50.74	4.1
1972	5	18	2	42	55.8	27.92	55.84	4.6
1972	10	9	23	49	53.2	28.17	56.03	5.2
1973	1	10	17	2	56	31.19	51.28	4.4
1973	5	31	19	50	36.9	28.23	56.17	4.7
1973	8	23	12	26	24.8	31.77	50.94	5
1973	8	28	12	27	26.5	32	50.9	4.8

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1973	11	9	18	50	50.4	27.72	55.52	4.5
1973	11	11	7	14	51.5	30.57	52.89	5.5
1973	12	19	18	26	9.3	28.15	54.98	4.8
1974	4	24	2	57	33.6	28.15	55.38	4.4
1974	5	4	22	8	24.5	31.83	50.6	4.5
1974	5	17	19	46	20.2	31.29	51.11	4.5
1974	6	5	16	0	13.1	30.5	52.4	4.1
1974	12	2	9	5	44.2	27.99	55.82	5.4
1975	3	7	15	36	40.2	28.13	56.41	4.3
1975	5	5	19	47	42.2	28.32	55.73	4.5
1975	9	5	3	49	21	28.63	55.34	4.5
1975	9	19	13	46	19.2	28.32	55.76	4
1975	9	21	14	16	37.8	31.6	51.04	5.2
1975	10	8	9	53	42.4	28.2	55.66	5.3
1975	10	8	8	15	50	28.44	55.65	4.8
1975	11	13	17	8	33.5	31.78	50.94	4.1
1976	6	13	21	33	22.2	28.11	55.58	4.7
1976	12	31	21	10	33.5	31.28	54.52	4.4
1977	1	12	1	49	4.4	31.83	50.49	3
1977	3	27	7	19	51.1	28.15	56.18	4.7
1977	4	1	20	43	35.3	31.98	50.68	4
1977	4	6	13	36	37.1	31.98	50.68	5.5
1977	4	12	23	20	5.1	31.98	50.75	4.9
1977	5	4	2	1	25.7	31.79	50.86	4.8
1977	5	25	21	6	38.3	29.34	53.39	4.8
1977	6	24	23	57	6	31.79	50.92	4.5
1977	10	21	14	56	6.9	31.79	50.83	5
1977	10	26	17	2	51.2	31.55	51.17	4.7
1978	2	11	21	40	13.1	28.21	55.42	5.2
1978	4	12	16	46	23.2	31.85	50.63	4.8
1978	6	27	20	14	20.3	29.92	53.72	4
1978	7	3	1	35	27.2	31.59	51.06	4.4
1978	7	28	2	42	34.3	31.15	49.76	4.4
1979	1	5	20	0	18.2	27.83	55.52	4.5
1979	3	4	5	43	42.8	28.3	56.26	4.9
1979	8	27	15	24	6.5	27.96	56.14	4.4
1979	9	18	17	16	31.4	30.56	54.62	4.2
1980	1	3	22	6	7.1	31.87	50.34	4.6
1981	1	6	7	23	44	28.2	56.53	5.1
1981	3	9	5	26	53.4	27.81	55.21	4.5
1982	7	12	3	28	46.18	28.87	55.4	4.4
1982	7	31	16	5	25.9	28.8	56.6	4.6
1982	9	5	6	14	7.7	31.93	50.39	4.7

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1983	3	30	16	30	36.52	28.16	56.359	4.1
1983	5	15	11	16	10.64	28.13	56.31	4.7
1984	4	13	21	44	12.01	27.56	55.36	4.5
1984	5	11	22	24	10.2	28.05	55.9	4.2
1984	6	1	12	29	27.7	31.95	50.53	5
1984	9	10	21	16	3.37	28.63	56.72	4.6
1984	12	6	11	31	18.66	27.52	55.63	4.7
1994	1	1	3	10	48.5	28.05	55.57	4.8
1994	3	11	20	37	16	30.2	54.5	4.3
1994	3	16	2	2	1	31.98	50.33	4.1
1994	4	14	0	0	0	28.24	55.29	4.6
1994	4	14	0	0	0	28.29	55.34	5.2
1994	4	20	0	0	0	28.29	55.33	4.8
1994	6	20	9	8	48.67	29.71	54.06	5
1994	7	14	0	0	0	28.07	55.49	4.6
1995	1	11	10	2	51.6	30.95	54.3	4.6
1995	1	11	10	1	59.59	30.96	54.44	4.2
1995	1	22	0	36	6.79	28.81	54.2	4.3
1995	1	29	18	9	27.31	28.86	56.22	4.1
1995	2	17	1	0	8.1	30.2	52.91	4.2
1995	2	17	16	0	20	30.7	54.73	3.8
1995	7	2	9	46	59.42	30.79	53.63	3.8
1995	7	23	8	37	22.34	27.99	55.45	3.7
1995	10	25	1	44	31.95	28.65	55.36	4.1
1996	8	24	5	15	49.51	31.47	52.15	4
1996	10	18	9	26	28	28.4	56.2	2.6
1997	4	19	10	11	12	31	54	4.5
1997	4	19	5	53	19.9	29.06	56.43	5.5
1997	4	22	17	39	24.85	29.19	53.87	3.8
1997	5	5	15	11	25.32	28.59	56.49	4
1997	6	25	19	40	50.22	31.46	54.29	4.7
1997	7	21	0	54	33	29.63	53.69	4.1
1997	7	27	1	59	19.6	30.7	52.85	4.6
1997	8	17	6	42	34.8	27.69	55.55	3.9
1998	1	5	15	56	27.5	29.15	56.23	4
1998	6	10	8	30	28.27	29.26	56.89	4.2
1998	7	19	18	38	16.52	31.24	53.13	3
1998	7	24	11	37	48.65	28.65	56.81	4
1998	10	24	21	27	35.92	30.27	52.44	3.7
1998	12	27	0	54	21	29.11	53.82	4.5
1999	1	14	22	12	43.8	29.15	56.46	4.9
1999	1	29	5	22	24.3	30.91	51.68	2.5
1999	9	17	20	14	41.46	29.44	53.56	4.6

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
2001	4	13	1	4	19.22	28.3	56.2	4.6
2002	4	14	21	39	50	28.1	55.16	4.4
2002	4	30	17	38	33	27.97	56.23	4.5
2002	7	8	5	44	0	31.87	50.69	4.6
2002	10	9	19	36	0.3	28.65	56.73	3.8

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
20	**Southern Yemen**	**17**	**45**	**408636**
		20.6	**48.4**	
		16	**54**	
		13.5	**46**	

Historical Events (Zone 20)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1916	6	21	0	59	0	15.7	52.1	4.8

Instrumental Events (Zone 20)

YR	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1997	7	31	16	11	43.03	16.4	53.34	4.9

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
21	**Rub Al Khali-Ghudun Basins**	**20.6**	**48.4**	**403580**
		24.2	**52.2**	
		19.6	**57.3**	
		16	**54**	

Historical Events (Zone 21)

Year	Mon	Day	HH	Min	sec	Lat	Long	Mag
1954	8	20	15	30	30	20	52.25	5.6
1956	5	8	0	0	0	18	52.8	4

Instrumental Events (Zone 21)

Year	Mon	Day	HH	Min	sec	Lat	Long	Mag
1994	11	3	11	43	41.6	23.49	51.95	3.4
1995	2	1	13	7	23.52	22.04	52.55	3.6
1995	6	12	21	58	37.52	21.61	53.65	3.6
1996	3	13	16	37	48	21.3	49.49	2
1997	8	20	7	22	44	20.05	51.45	5
1997	9	17	15	0	32.34	21.18	54.12	4.6

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
22	**Bandar Abbas-Dibba Region**	**24.2**	**52.2**	**140096**
		28.8	**57.3**	
		27.5	**58.6**	
		22.8	**53.8**	

Historical Events (Zone 22)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1361	0	0	0	0	0	26.81	55.91	$5.3M_s$
1426	11	0	0	0	0	26	56.5	5
1497	0	0	0	0	0	27.7	54.3	$6.3M_s$
1884	5	19	0	0	0	26.81	55.91	5.4
1897	1	10	0	0	0	26.95	56.26	6.4
1902	7	9	3	38	0	27	56.4	6.4
1905	4	25	14	1	0	27	56	5.8
1927	5	9	10	31	47	27.5	56	5.5
1928	4	27	0	0	0	27.6	57.8	4
1928	8	14	0	0	0	27.6	57.8	4
1931	5	5	6	42	15	26.5	54.8	5.1
1931	5	7	0	0	0	26	54.8	4
1933	2	21	0	0	0	27.5	57.5	4

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1933	2	26	0	0	0	27.5	57.5	4
1934	2	16	7	59	50	26	54.8	4.9
1934	2	26	0	0	0	27.5	57.5	4
1935	7	2	15	24	59	25.5	55.2	5.1
1936	4	21	2	14	38	26.3	55.3	6.2
1936	6	17	8	40	53	25.5	55.2	4.6
1936	8	16	21	37	1	26.6	55.6	5.1
1940	12	16	0	0	0	28	57	4
1945	1	11	0	0	0	26.3	55.4	4
1945	1	15	17	21	33	26.3	55.4	5.6
1947	5	4	22	34	40.8	26.3	55.4	5.1
1947	10	3	6	13	51	27.5	58	5.8
1948	2	1	23	38	28	27	58	5.3
1948	6	18	0	0	0	27.5	57.8	4
1949	4	24	4	22	14	27	56	6.5
1949	7	4	3	40	40	27.5	56	4
1949	7	5	0	0	0	27.2	56.2	4
1949	8	5	0	0	0	27.2	56.2	4
1949	11	22	15	21	12	28	57	4
1950	2	2	15	46	0	25.5	54	4.7
1950	2	2	22	45	13	25.5	54	4.7
1951	12	30	0	0	0	28	57	5.5
1952	7	12	0	0	0	26.75	57	4
1953	1	15	0	0	0	25.8	54.5	4
1953	6	6	0	0	0	28.4	57	4
1954	2	28	21	23	43	27	56	5
1954	10	12	0	0	0	26.75	56.5	4
1955	3	13	0	0	0	28	56.75	4
1956	6	29	0	0	0	27.5	57	4.5
1956	11	10	8	18	55	25.9	54.75	5
1957	9	23	0	0	0	27	58	4
1957	10	2	13	9	8	26.5	55	5.5
1958	6	24	0	0	0	27.5	56	4
1958	12	23	0	0	0	27	57	4
1959	3	18	0	0	0	27	56	4
1960	1	2	0	0	0	25.75	55	4
1961	4	6	18	12	40.7	27.9	56.7	4
1961	9	28	22	36	24.7	27.2	57.1	4
1962	3	7	21	8	3.1	26.9	57.2	4
1962	4	26	15	53	12.2	28.5	57.2	4
1962	6	30	9	45	50.2	27.6	57.7	4
1962	7	14	6	44	26.5	27.3	56.7	4
1962	9	29	6	53	56.1	28.2	57.4	4
1963	1	24	15	42	13	28.2	57	4
1963	2	8	6	3	9.7	26.5	55.2	4.1
1963	5	20	10	19	20	25.7	56.5	4.8

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1963	7	6	13	34	4.1	28	57.6	4
1963	7	8	8	58	4.8	26.7	55.7	4.8
1963	10	31	9	57	1	27.4	55.6	5.3
1964	3	11	23	34	21.2	27.7	57.5	4.6
1964	5	11	6	7	41.5	28.3	57.4	4.9
1964	7	21	11	46	54	27.7	56.5	4
1964	8	12	19	26	26.1	27.2	56.4	4.7
1964	8	27	11	58	41.3	27.5	55.9	5.3
1964	12	19	23	31	57.3	28	56.9	5.3
1964	12	19	23	31	57.3	28	56.9	5.3
1964	12	22	4	36	34.7	28.2	57	5.5
1964	12	23	10	52	17.5	27.9	57	4.8
1964	12	24	2	6	4.8	28.1	57.4	4

Instrumental Events (Zone 22)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1965	3	17	7	18	55.9	27.8	56.5	4.9
1965	4	19	1	20	4.2	28.2	56.6	4.7
1965	7	30	19	7	2.9	27.9	57	4.7
1965	11	8	1	57	26.9	27.9	56.9	5.3
1966	1	13	3	41	42	27.5	57.1	4
1966	7	8	3	51	3.9	26.5	54.6	4.5
1966	7	9	17	1	46.7	27.8	57.1	4
1967	1	29	7	5	58.8	26.4	55.27	4.8
1967	1	29	7	12	5	26.47	55.2	5
1967	1	29	3	53	58	26.49	55.29	4.7
1967	1	29	13	20	26.1	26.49	55.31	5
1967	1	29	7	56	40.3	26.54	55.3	4.9
1967	1	31	19	0	26.3	26.41	55.32	5
1967	1	31	20	6	36.3	26.57	55.25	5.1
1967	1	31	20	52	48.2	26.62	55.36	4
1967	2	1	14	21	7.8	26.61	55.24	4.9
1967	2	1	1	7	19.3	26.73	55.17	4
1967	3	1	10	12	48.4	28.03	56.85	5.1
1967	4	28	19	38	27.3	27.74	57.17	4.7
1967	6	7	22	35	16.1	26.9	58	4.4
1967	9	14	14	49	41.9	28.4	57.1	4.7
1968	1	10	10	43	47.9	27.4	56.2	4.6
1968	4	23	12	39	47.3	27.7	56.7	5.1
1968	7	8	11	27	24	27.96	56.98	4
1968	8	26	5	59	9.7	26.68	54.99	4.6
1969	5	12	19	9	9	27.81	56.52	4.9
1969	6	21	16	35	8.3	27.36	57.51	5.3

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1969	7	20	22	37	29.6	28.2	57.33	4.9
1970	2	28	19	58	48.1	27.83	56.32	5.5
1970	3	6	19	40	7.3	28.24	57.47	4.7
1970	3	10	22	6	24.4	28.41	57.48	4.7
1970	4	1	23	54	5.6	28	56.74	5.1
1970	10	7	2	20	36.7	27.78	56.5	5
1970	10	20	10	34	19.3	27.61	56.68	4.9
1970	10	27	20	11	4.8	26.51	55.29	4.4
1970	12	26	19	52	3.7	27.83	57.87	4.8
1971	1	28	6	9	27.2	28.5	57.44	4.6
1971	10	5	22	45	4.3	27.19	55.79	5.1
1971	11	3	9	42	50.4	28.26	56.96	4.7
1971	11	4	4	10	13	28.1	57.4	4
1971	12	9	2	36	12.2	27.24	56.4	5.3
1971	12	9	1	42	30.7	27.32	56.39	4.5
1971	12	9	2	53	59.7	27.43	56.43	4.9
1971	12	20	23	27	38.5	28.35	57.23	4.9
1972	3	8	21	49	10.6	27.61	56.74	4.9
1972	4	3	8	6	6.9	28.12	57.19	5
1972	6	30	17	49	33.6	27.2	56.82	4.6
1972	8	2	21	33	6.3	28.08	56.85	5
1972	8	2	23	3	28.9	28.22	56.95	4.7
1972	8	2	23	12	13.4	27.86	56.8	4
1972	8	3	22	47	45.5	28.21	56.99	4.8
1972	11	4	9	32	22	28.54	56.99	4.9
1973	4	25	8	35	37.4	26.84	55.44	4.6
1973	5	6	3	59	19.6	27.3	55.52	4.9
1973	5	24	23	14	33.2	28	57.93	4.5
1973	6	10	20	12	42.1	27.69	56.29	4.2
1973	8	25	14	58	10.8	28.08	56.76	5.4
1973	8	25	16	31	57.2	27.98	56.71	4.2
1973	12	10	21	6	47.6	27.99	56.99	4.6
1974	1	21	5	32	26.2	28.17	57.62	3.6
1975	3	7	7	4	42.6	27.26	56.59	4.2
1975	3	7	21	4	44	27.31	56.32	4.6
1975	3	7	23	25	25.5	27.47	56.25	5.2
1975	3	7	10	42	25.4	27.5	56.26	5.8
1975	3	7	18	58	29.2	27.55	56.37	4.1
1975	3	7	14	26	56.5	27.56	56.3	4.7
1975	3	7	12	14	25.6	27.58	56.17	4.1
1975	3	7	17	42	30.4	27.61	56.3	4.6
1975	3	8	0	8	52.6	27.61	56.27	3.9
1975	3	9	6	39	43.6	27.36	56.29	4.4
1975	3	9	18	22	14.6	27.38	56.27	4.9

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1975	4	12	4	13	6.6	27.41	56.43	4.8
1975	5	17	16	19	12.5	27.52	57.74	4.9
1975	6	12	14	8	6.2	27.3	55.83	4.4
1975	6	20	14	10	47.1	27.62	58.71	4.8
1975	8	27	16	59	31.2	27.5	56.21	5.1
1975	9	1	16	53	49.5	27.55	56.17	4.3
1975	9	4	23	29	7.8	26.76	56.74	4.5
1975	9	22	23	0	7.1	28.31	56.81	3.6
1975	11	1	18	1	53.3	26.92	56.29	4.4
1975	11	6	10	15	42.2	27.36	56.08	4.9
1975	12	17	13	34	53.5	27.93	57.11	4.8
1975	12	19	12	46	31.1	28.21	57.15	4.6
1975	12	19	8	2	8.4	28.62	56.98	4.7
1975	12	24	11	35	7.1	26.83	55.46	4.4
1975	12	24	20	50	44.3	26.98	55.48	4.2
1975	12	24	18	40	32.9	27.01	55.54	5.5
1975	12	24	11	48	56.8	27.01	55.57	4.7
1975	12	24	21	4	13.1	27.03	55.54	4.7
1975	12	24	19	55	11	27.08	55.5	5
1975	12	25	21	59	58.5	26.49	55.75	5.2
1975	12	26	1	7	40.6	26.72	55.57	4.3
1975	12	26	5	46	43.6	26.93	55.45	4.5
1975	12	27	21	8	8.2	26.84	55.54	4.4
1975	12	30	1	9	35.4	26.84	55.51	4.8
1976	1	2	4	30	32.5	28.62	48.95	4.1
1976	1	2	14	29	10.9	27.02	55.69	3.9
1976	2	24	7	30	57.9	27.23	55.82	3.8
1976	3	7	0	42	29.4	28.1	57.34	4.4
1976	3	10	4	39	17.5	28.37	57.38	4.7
1976	3	31	2	34	22.3	28.15	56.63	4.9
1976	4	24	10	19	43.8	27.95	56.68	4.8
1976	6	11	8	32	13.3	27.04	57.37	4.1
1976	9	26	19	39	28.5	27.75	56.61	4.3
1976	10	24	16	20	59.4	27.58	56.71	5.1
1976	10	26	1	0	23.1	27.18	58.06	4.6
1976	11	6	23	18	52.8	28.24	57.14	4.8
1976	11	13	10	11	15.6	28.18	57.4	5
1976	11	13	10	12	32.5	28.23	56.82	4.5
1976	12	9	20	2	26.2	27.62	56.16	4.6
1977	1	5	5	44	39.9	27.46	56.2	5.5
1977	3	20	23	56	53.3	26.85	56.45	4.6
1977	3	21	21	41	23.8	27.24	56.77	4.7
1977	3	21	21	33	18.2	27.34	56.37	4.4
1977	3	21	23	56	58.4	27.38	56.27	4.7

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1977	3	21	22	42	6.5	27.4	56.47	4.9
1977	3	21	21	51	39.3	27.5	56.36	5.1
1977	3	21	21	18	54.2	27.6	56.52	5.8
1977	3	21	22	42	13.5	27.61	56.39	6.2
1977	3	21	21	50	48.4	27.62	56.36	4.9
1977	3	21	22	27	44.7	27.73	56.43	4.7
1977	3	22	4	48	0.8	27.29	56.5	4.5
1977	3	22	4	47	53.4	27.51	56.25	4.7
1977	3	22	5	32	2.2	27.53	56.32	5.2
1977	3	22	2	42	13.4	27.54	56.47	4.4
1977	3	22	11	57	30.9	27.58	56.47	5.7
1977	3	22	1	37	9.1	27.58	56.59	4.8
1977	3	22	5	32	4.5	27.59	56.53	4.5
1977	3	22	3	18	26.1	27.59	56.55	5
1977	3	22	7	29	39.9	27.64	56.65	4.5
1977	3	22	2	25	58.8	27.65	56.33	5.2
1977	3	22	1	28	18.8	27.71	56.37	4.8
1977	3	22	2	42	10.2	27.72	56.46	4.9
1977	3	23	20	40	57.9	27.52	56.48	4.9
1977	3	23	2	31	39.1	27.55	56.29	4
1977	3	23	13	45	13	27.56	56.38	4.9
1977	3	23	10	11	7.6	27.61	56.53	4.9
1977	3	23	7	46	59.4	27.62	56.59	5.8
1977	3	23	0	17	50.8	27.65	56.45	5
1977	3	23	23	51	15.8	27.8	56.21	4.6
1977	3	24	4	42	24.3	26.92	56.63	4.6
1977	3	24	14	10	46.4	27.58	56.46	5.1
1977	3	24	0	4	50.7	27.62	56.63	5.3
1977	3	24	13	57	51.7	27.74	56.51	4.7
1977	3	24	0	13	52.3	27.84	56.57	4.8
1977	3	25	22	55	23.7	27.77	56.63	4.9
1977	3	26	14	27	55.3	27.39	56.19	4.9
1977	3	26	0	32	37.7	27.57	56.58	4.9
1977	3	28	3	6	26.8	27.59	56.55	4.9
1977	3	29	23	25	11.9	27.5	56.51	4.6
1977	3	29	22	29	16.8	27.6	56.41	5.2
1977	3	30	8	29	15	27.57	56.51	4.4
1977	3	31	19	11	21.4	27.59	56.29	4.7
1977	3	31	10	6	7	27.69	56.56	4.7
1977	3	31	13	36	29.8	27.72	56.54	4.6
1977	3	31	19	11	28.2	27.78	56.2	4
1977	4	1	13	36	24.7	27.27	56.56	5.1
1977	4	1	6	59	3.6	27.31	56.35	4.8
1977	4	1	16	0	25.2	27.55	56.33	6.2

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1977	4	1	6	59	13.5	27.59	56.25	4.9
1977	4	1	20	43	24	27.7	56.17	5.1
1977	4	2	6	53	34.5	27.7	56.17	4.8
1977	4	7	3	34	38.1	27.9	57.06	4.9
1977	4	8	16	49	42.9	27.45	56.3	4.7
1977	4	10	5	2	15.4	27.5	56.15	4.5
1977	4	11	3	10	4.5	27.49	56.2	4.8
1977	4	13	4	39	2.7	27.37	56.12	4
1977	4	17	17	15	14.5	27.15	56.62	4.6
1977	4	17	3	47	25.8	27.21	56.44	4.8
1977	4	17	13	4	44.9	27.6	56.44	4.2
1977	4	20	4	22	24.8	26.94	55.47	5.1
1977	4	30	16	14	2.9	27.6	56.49	4.2
1977	4	30	14	35	37.3	27.88	56.27	5
1977	5	20	12	25	18	27.29	56.57	4.8
1977	5	24	12	59	9.3	27.07	55.48	4.7
1977	5	24	12	43	28.7	27.11	55.45	4.8
1977	5	26	22	39	29.1	27.65	56.55	4.8
1977	6	25	17	43	31.1	27.75	56.16	4.4
1977	6	26	2	25	29.4	27.53	56.08	4.8
1977	6	28	3	44	55.1	27.61	56.15	4.9
1977	7	26	1	18	0	27.51	56.42	4.8
1977	8	12	0	12	10.2	26.76	55.15	4.2
1977	9	13	0	16	7.4	27.67	56.49	4.7
1977	9	15	16	4	54.8	27.36	56.51	3
1977	9	20	22	47	23.5	27.48	56.48	4
1977	12	1	21	11	17.9	27.61	56.59	5.1
1977	12	1	23	28	17	27.66	56.57	5.1
1977	12	2	3	50	42.7	27.67	56.6	4.5
1977	12	10	5	46	22.9	27.69	56.57	5.1
1977	12	11	8	11	1.5	27.39	56.59	4.7
1978	2	13	18	41	49.1	27.46	56.58	4.2
1978	2	22	20	18	9.4	28.03	56.9	5.1
1978	2	23	23	24	47.8	28.06	56.9	5.2
1978	3	1	9	53	46.4	27.39	56.4	4.6
1978	4	11	22	49	25.8	27.53	56.18	4.5
1978	5	26	12	22	21.5	27.61	56.53	4.5
1978	6	18	13	26	0	27.44	56.58	4.7
1978	7	21	18	40	34.5	27.94	57.62	4.3
1978	7	29	8	8	38.1	27.7	56.23	4.4
1978	8	2	6	54	29.2	27.24	55.9	4.5
1978	8	27	20	18	6.7	27.16	56	4.4
1978	9	6	13	0	53.4	28.16	57.17	4.6
1978	9	9	22	38	5.2	27.44	56.47	4.3

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1979	1	15	12	26	54.7	27.73	56.54	4.6
1979	3	11	2	9	3.9	27.41	57.69	4.5
1979	4	25	7	32	14.3	27.61	56.62	4.7
1979	7	21	15	8	33.9	27.98	57.12	4.6
1979	8	14	23	24	23.3	28.44	57.01	4.8
1979	9	29	18	5	56.1	26.7	55.4	4.4
1980	2	13	17	32	22.5	28.03	57.49	4.5
1980	5	28	10	59	23.3	28.3	57.58	4.8
1980	6	11	23	41	46.9	28.39	57.92	4.7
1980	7	20	10	3	28.6	27.44	56.05	4.7
1980	9	10	14	38	12.7	28.03	57.73	4.6
1980	11	15	1	53	6.7	27.8	56.01	4
1980	11	17	18	26	30.3	27.36	56.08	5.1
1980	11	28	2	11	31.3	27.59	56.5	5.5
1981	1	30	23	27	35.3	27.62	56.58	4.3
1981	4	16	10	27	16	27.73	56.35	5.3
1981	5	18	19	36	12.4	26.95	55.26	4.8
1981	7	3	3	52	1.2	27.15	55.76	5.3
1981	9	8	17	3	13.43	28.5	56.95	4.5
1981	9	12	2	29	16.4	27.86	56.98	4.8
1982	1	3	7	25	17.03	28.22	57.08	4.4
1982	1	17	20	57	12.56	27.67	56.68	5
1982	2	28	13	42	3	28.58	57.16	4.5
1982	3	23	10	48	28	27.61	57.32	4.9
1982	7	11	13	19	50.9	27.83	56.26	5.3
1982	10	15	8	37	53	28.09	57.31	5.1
1982	11	10	11	28	27.99	26.51	54.93	4.7
1982	12	12	2	56	27.13	27.43	55.95	4.6
1983	7	12	18	1	58.95	27.56	56.42	4.4
1983	7	12	11	41	27.08	27.6	56.54	4.9
1983	7	12	11	34	17.57	27.61	56.38	5.9
1983	7	15	1	57	29.86	28.06	56.98	4.9
1983	7	15	2	1	14.85	27.71	57.94	5
1983	8	9	22	15	16.08	28.014	56.82	4.5
1983	10	29	2	37	2.4	28.54	57.05	4.9
1983	12	2	10	45	8.47	27.92	56.66	4.8
1984	2	29	10	1	7.24	26.87	55.65	4.9
1984	4	22	13	39	31.02	27.64	56.61	4.9
1984	4	25	18	34	53.3	28.23	57.77	4.1
1984	8	28	22	21	5.1	26.17	54.41	4.8
1984	10	10	10	19	54.84	26.78	54.92	5
1985	5	17	17	1	23.8	26.62	57.36	4.7
1985	7	4	23	38	5.9	27.69	56.32	4.5
1985	10	1	9	48	43.55	28.47	56.92	4.6

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1994	3	3	14	12	23	27.92	57.23	4.7
1994	7	1	0	0	0	27.65	56.51	5
1994	9	17	0	0	0	26.45	55.6	4.7
1994	10	1	0	0	0	27.15	57.55	5
1994	10	28	0	0	0	26.54	56.5	4.2
1994	11	19	0	0	0	27.82	56.89	4.6
1995	1	3	2	22	3.82	28.46	57.72	4.2
1995	1	4	2	22	3.7	28.46	57.72	5.2
1995	1	24	6	58	56.63	27.33	56.46	1.5
1995	1	24	4	14	29.68	27.84	56.11	2
1995	1	25	19	36	13.47	24.25	54.18	4.3
1995	1	27	23	4	0.25	28.41	57.85	4.6
1995	9	4	17	47	41.66	27.61	55.99	4
1995	10	8	1	38	24.05	27.04	59.32	4.1
1996	7	22	12	32	57.3	27.57	56.59	4.8
1996	7	22	16	37	3.7	27.59	56.52	4.5
1996	7	22	21	31	2.6	27.7	56.37	4.8
1996	7	22	21	28	11.8	27.7	56.55	4.5
1997	7	9	17	39	16.7	28.6	57.58	4.5
1997	7	9	16	58	43.4	26.15	55.78	4.8
1997	7	21	4	58	41.7	28.17	57.85	4.2
1997	7	27	23	23	17.9	27.45	57.43	4.9
1997	8	17	7	8	33.75	24.65	54.68	3.7
1997	9	17	15	14	1.04	27.51	58.08	4.7
1997	10	6	16	11	33.76	27.74	57.92	3.7
1997	11	1	13	38	36.41	28.66	57.17	3.6
1998	6	13	15	50	51.91	27.13	55.67	4.1
1999	3	24	5	38	26	28.31	57.17	6.2M_s
2000	3	5	9	40	4.97	27.54	56.73	4.7
2000	3	31	21	33	9.8	27.14	55.41	4.3
2001	8	12	11	3	26	27.3	57.95	4.5
2001	11	22	17	0	2	27.14	57.42	4.5
2001	11	25	21	30	54	28.26	57.3	5
2001	12	5	14	18	37	27.73	56.24	4.7
2002	2	23	17	9	36	26.65	54.73	4.6
2002	3	11	20	6	37	25.23	56.13	5.1
2002	4	4	15	44	31	27.01	55.34	4.7
2002	4	11	6	5	49	27.7	56.67	4.8
2002	4	25	9	35	14	27.34	56.71	4.1
2002	5	28	19	5	34	27.75	56.75	4.7
2002	6	2	20	8	25	27.88	57.6	4.7
2002	6	2	20	17	27	27.76	57.6	4.4

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
23	**Makran-Hawasina Thrust Zone**	**22.8**	**53.8**	**324060**
		27.5	**58.6**	
		25	**61.8**	
		19.6	**57.3**	

Historical Events (Zone 23)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1483	2	18	0	0	0	25.7	57.3	$7.7M_s$
1883	10	13	0	0	0	22.9	57.5	5.2
1905	5	13	0	0	0	23.6	58.6	5.5
1924	12	11	23	1	0	25.2	56.8	5.1
1928	9	20	14	59	0	25.2	56.8	4.6
1940	5	5	0	0	0	24.7	57.5	4
1949	7	21	0	0	0	26.3	58.7	4
1959	2	3	0	0	0	26	57.5	4

Instrumental Events (Zone 23)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1967	4	27	20	47	48.7	26.72	58.04	4.4
1977	6	15	3	22	53.2	26.76	58.77	4.8
1983	5	20	22	29	28.54	27.13	59.15	4.5
1995	1	3	11	21	32	24.1	58.04	3.8
1995	1	17	6	3	30.79	20.86	57.01	2.1
2002	3	10	4	55	14	25.04	58.1	4.5

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
24	**East Sheba Ridge**	**16**	**54**	**209585**
		17.9	**55.6**	
		13.8	**59.5**	
		12	**57.5**	

Zone No.	Name	Coordinates		Area (KM^2)
		Lat. N	Long. E	
		14	**54.8**	

Historical Events (Zone 24)

Year	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1899	8	17	20	38	0	16	56	6.6
1916	6	19	3	50	0	16	57	5.6
1916	6	24	4	3	0	14	59	5.3
1925	2	1	0	0	0	15.5	56.5	4
1927	10	23	0	0	0	15.5	56.5	4
1928	6	11	0	0	0	15.5	56.5	4
1935	1	18	2	8	37	14.5	56	5.5
1951	7	21	3	22	57	14	55	5.3
1952	10	10	13	6	0	16	56	4
1953	4	23	0	0	0	14.5	56.25	4
1955	4	26	1	37	20	14.59	56.34	6
1959	4	14	0	0	0	14.09	56.5	4
1961	2	7	2	57	56	14.8	54.3	5
1961	4	6	21	23	59.2	15.3	54	4
1961	10	25	16	24	20.8	14.2	56.6	4
1962	8	15	13	8	41.2	14.6	56.5	4
1962	11	29	2	20	27.8	14	55.1	4
1963	7	21	6	1	57.3	14.8	56.1	5.1
1964	3	19	9	42	34.9	14.7	56.3	4
1964	5	23	0	11	56.9	14.6	56.3	4

Instrumental Events (Zone 24)

Year	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1966	3	27	1	40	59.5	14.4	56.7	5.1
1966	7	1	17	26	13.7	14	56.9	4.9
1966	9	14	0	47	5	14.5	56.4	5
1967	4	12	19	28	57.2	14.36	56.62	4.7
1967	4	13	21	43	13.5	14.51	56.38	4.1
1967	4	14	18	58	20.2	14.45	56.57	4.7
1967	10	15	6	36	39.7	14.7	56.4	5.1
1967	12	11	19	48	43.3	14.9	56	4.5
1968	2	8	10	58	22.1	14.6	54	5.4

Year	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1968	8	30	22	2	19.8	14.62	56.25	5.2
1969	2	25	1	30	8	14.34	56.34	4
1969	5	11	0	18	41.9	14.34	56.75	5.1
1971	3	19	13	27	11.7	14.58	56.23	5.3
1972	3	5	6	5	29.8	14.46	56.41	4.5
1972	8	6	16	44	37.6	14.41	55.61	5.1
1972	8	6	15	53	55.6	14.64	55.84	4.7
1972	8	6	15	36	55.4	14.71	55.62	5.2
1972	8	6	16	6	9.4	14.72	55.59	4.7
1972	8	6	7	0	56.2	14.76	55.59	5.3
1972	9	20	20	44	53.2	14.25	56.52	4.9
1972	9	20	20	52	36.2	14.42	56.64	5.3
1973	5	13	11	19	36.5	14.75	55.67	5
1974	2	3	8	54	9.1	14.5	56.09	4.8
1974	2	3	6	27	23.2	14.52	55.74	5
1974	2	11	17	6	15.8	15.02	56.22	4.3
1975	4	19	18	49	45.2	14.21	56.21	4.7
1975	4	19	17	21	35.2	14.34	56.19	4.7
1975	4	19	13	45	50.1	14.39	56.15	4.9
1975	4	19	21	29	50.8	14.41	56.43	5.1
1975	4	19	18	43	59.1	14.42	56.45	5.4
1975	4	19	19	16	45.6	14.42	56.52	5.3
1975	4	19	21	57	26.6	14.46	56.2	5.1
1975	4	19	17	33	26.9	14.46	56.38	5.1
1975	4	19	17	38	38.6	14.46	56.47	4.1
1975	4	19	17	9	32.2	14.47	56.33	5.2
1975	4	19	23	29	13.4	14.48	56.63	4.8
1975	4	19	17	50	52.7	14.5	56.41	5
1975	4	19	17	26	42.5	14.51	56	5
1975	4	19	20	15	43.5	14.51	56.22	5.1
1975	4	19	19	9	27.4	14.51	56.35	5.1
1975	4	19	17	10	54.8	14.51	56.51	5
1975	4	19	21	21	13.6	14.55	56.07	5.1
1975	4	19	18	9	27.9	14.55	56.41	4.8
1975	4	19	18	5	15.8	14.55	56.45	5
1975	4	19	17	45	59.2	14.57	56.26	5.2
1975	4	19	18	16	11.6	14.58	56.19	4.7
1975	4	20	8	56	49.8	14.13	56.35	5
1975	4	20	0	59	50.5	14.19	56.51	5
1975	4	20	2	6	32.7	14.3	56.39	5
1975	4	20	22	42	44	14.36	56.59	4.8
1975	4	20	3	41	6.5	14.45	56.49	5.1
1975	4	20	21	22	47.1	14.54	56.25	4.8
1975	4	20	5	9	42.4	14.58	56.4	5

Year	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1975	4	20	9	55	6.3	14.59	56.15	4.8
1975	4	20	14	39	8.8	14.61	56.52	5
1975	4	21	15	7	23.1	14.4	56.51	4.9
1975	4	21	21	4	37.2	14.41	56.01	5
1975	4	21	3	54	18.2	14.42	56.22	4.6
1975	4	21	2	25	56.7	14.44	56.42	4.9
1975	4	21	11	52	15.9	14.56	56.14	4.7
1975	4	22	22	17	49.5	14.38	56.54	4.8
1975	4	22	21	35	26	14.4	56.47	5
1975	4	22	3	38	56.7	14.5	56.51	5.2
1975	4	22	6	35	36.8	14.54	56.59	5.2
1975	4	22	8	31	20.6	14.58	56.27	4.7
1975	4	22	23	27	13	14.64	56.38	5
1975	4	22	18	25	37.8	14.72	54.88	5
1975	4	22	0	34	49.6	14.73	54.86	5
1975	4	22	15	23	5.3	14.84	56.92	5
1975	4	23	8	17	36.2	14.29	56.53	5.2
1975	4	23	12	5	31.8	14.43	56.69	4.9
1975	4	23	10	8	1.7	14.47	56.66	5.2
1975	4	23	15	2	10.5	14.48	56.67	5
1975	4	23	15	12	4	14.49	56.7	4.9
1975	4	23	0	0	0	14.57	56.46	5
1975	4	23	5	12	49.1	14.59	56.31	5.2
1975	4	24	3	59	52.7	14.39	56.44	5
1975	4	24	0	5	41.9	14.51	56.47	4.7
1975	4	26	19	36	12.7	14.56	56.58	4.8
1975	4	29	12	3	10.2	14.58	56.47	5.1
1975	4	30	23	40	30	14.68	56.13	5.1
1975	5	1	23	7	42.9	14.57	56.44	5.1
1975	5	24	1	32	36.2	14.34	56.29	4.9
1975	5	24	21	58	47.2	14.42	56.12	4.8
1975	5	25	20	30	11.1	14.34	56.3	4.9
1975	5	25	1	32	36.2	14.41	56.22	5.1
1975	9	6	8	28	21.2	14.62	56.08	4.3
1977	2	11	16	45	57.3	14.66	54.57	4.7
1977	2	28	17	35	6.5	14.81	55.01	5.1
1977	2	28	8	43	55.7	14.88	54.95	5.1
1980	10	23	8	43	35.8	14.68	54.17	4.8
1981	12	5	18	46	57	14.57	58.09	5.6
1994	1	5	0	0	0	14.53	55.3	4.5
1994	2	18	0	0	0	14.13	56.25	5.2
1994	2	18	16	22	5.3	14.29	56.23	5
1994	2	18	0	0	0	14.55	56.16	4.7
1994	5	23	0	0	0	14.66	54.47	4.5

Year	MON	DAY	HR	MIN	SEC	lat	lon	MAG
1994	5	26	0	0	0	14.77	54.84	3
1994	5	27	0	0	0	15.12	57.77	4.6
1994	6	13	0	0	0	14.65	54.4	4.5
1994	6	17	0	0	0	14.47	54.53	5
1994	11	20	0	0	0	14.77	55.61	5
1997	3	6	6	41	10.66	15.2	55	4
2001	7	14	21	7	44	14.69	55.63	4.9
2001	7	14	21	42	40	14.62	55.54	5.5
2002	8	13	7	51	16	14.68	55.92	5.1
2002	8	13	8	40	58	14.71	55.88	5.7
2002	8	14	16	33	5.6	14.72	55.89	4.8

Zone No.	**Name**	**Coordinates**		**Area (KM^2)**
		Lat. N	**Long. E**	
25	**Masirah Fault Zone**	**17.8**	**55.6**	**238136**
		19.6	**57.3**	
		22.4	**59.3**	
		21.6	**60.2**	
		16.8	**56.9**	

Historical Events (Zone 25)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1900	10	10	3	2	0	16	60	6.5
1930	10	9	21	30	30	21	60	5.2
1931	6	24	23	47	4	15	59.5	5.4
1935	10	20	4	51	30	18	60	5.3
1939	2	25	5	5	8	21	60	5.3
1956	1	29	0	0	0	16.5	58	5.5
1963	10	4	13	29	44	18	60	5.4

Instrumental Events (Zone 25)

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1971	3	3	2	15	58.1	22.1	59.24	5.1
1976	5	6	1	18	15	17.09	59.98	4.9

Year	Mon	Day	HH	Min	Sec	Lat	Long	Mag
1983	3	15	12	23	45.97	16.99	59.87	5.2
1984	5	7	15	27	44.03	16.93	59.91	4.7