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parallel to the Zagros Fault trend. Agar claims early pre-Cambrian dextral shear, followed by a reversal to sinistral shear. While measured and/or interpreted offsets along the Zagros Fault involve much younger rocks, one wonders whether the Zagros Fault System also follows a much older shear zone of similar trend. Perhaps it should not surprise us if it also exhibits a reversal in the sense of strike slip offset from Paleozoic- early Mesozoic to late Cretaceous- Recent (the Zagros Event).

It is not yet possible to place even approximate upper and lower limits to the dating of left- lateral Zagros offsets, except that a post- Permian (or earlier?) to pre-Santonian or pre- Cenomanian interval of time seems indicated by isopach, facies, and paleogeologic mapping carried out elsewhere by the writer.

Thus far no attempt is being made to rationalize the Permian offset discussed herein with respect to published notions of continental breakup, drift or wandering of the continents on a very large scale, and the return and collision of continents along the Zagros "suture". There may, or there may not, turn out to be a conflict of theories here. But first, before any attempt at resolution of these questions, a future project is planned to investigate the distribution, thickness and facies of Devonian, Silurian and Cambro- Ordovician sediments, as well as the Infracambrian Hormoz salt basins or sub- basins, on either side of the Zagros Main Fault.

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imaginable aspect of the fault except the possibility of significant strike slip movement.That same year Tchalenko and Braud (1974) examined historical seismicity and geologically recent tectonic deformation along one segment of the Zagros Main Fault. They mapped both thrust and right- lateral slip components, but remained cautious about extending their strike-slip findings regionally to the whole length of the Zagros Fault trend.

Gidon, Berthier, Billiault, Halbronn and Maurizot (1974) for the first time documented a series of field observations in which dextral offsets of streams, facies, structures, and even mountain ranges, were noted across the Zagros Main Fault.These amounted to 1 to 3 kilometers for recent stream offsets, 2.8 kilometers for certain Quaternary gravels, 15 to 20 kilometers for the Oshtoran Kuh-Kinarabad mountain chains, and other offsets certainly measured in tens of kilometers- probably as much as 60 Kilometers- in the Borujerd- Dorud area.

One of the best simple statements linking the NW striking TertiaryQuaternary Zagros- North Anatolian fault system to the SW striking East Anatolian Fault as "a pair of conjugate wrench faults" is given by Brinkmann (1976). However Snyder and Barazangi (1986), using the old thrust model, utilize all sorts of quantitative gravity and crustal thickness calculations in a series of two dimensional profiles across Central and coastal Iran, but make no mention of possible lateral slip offsets.

More recently, in an elegantly written quantitative treatment of the past 70 years of seismicity by Jackson and McKenzie (1988), fault plane solutions and other calculations on historical Iranian earthquakes indicate right- lateral components of slip, especially in the northwestern Zagros, averaging about 1.0 cm per year.The earthquake of 23 January 1909 involved more than 2 meters of right-lateral slip.Progressively greater thrust components and lesser strike slip components are reported along the Zagros trend toward the southeast during the 70 year observation period.

In contrast, the North Anatolian Fault during the past 70 years is involved in an estimated average annual right-lateral east-west motion of about 4 cm per year. Southeastward, along the "Zagros" continuation of the North Anatolian Fault System, there has been too little seismicity during the last 70 years to allow for similar annual lateral slip calculations, where "a substantial part of the deformation may occur in large, relatively infrequent earthquakes every few hundred years" (a deliciously imprecise characterization by Jackson and McKenzie, 1988). However, predicted slip rates were calculated as about 1.0 cm per year for the northern part of the Zagros Fault (right-lateral), and about 3.4 cm per year for the East Anatolian Fault and 5.0 cm per year for the Dead Sea Rift (both left-lateral).

Postulated Early Mesozoic Sinistral Offset of Zagros Fault

Triassic and Carboniferous isopachs cannot be drawn on the north- east side of the Main Zagros Fault because of extensive erosion and/or current lack of information. For the Permian, however, enough thickness and facies information is available to permit crude contouring and a possible correlation of isopach trends and even facies trends across the Main Zagros Fault.

In spite of the well documented Tertiary-Quaternary dextral offsets and thrust components, it is suggested that the offset of the older (Permian) rocks on either side of the Main Zagros Fault seems to be about 465 Kilometers (260 miles) in a left-lateral sense. Several pieces of evidence have led to this conclusion:

1. The Permian isopachs of Map 3 do not match very well across the Main Zagros Fault.

2. The 7,000 foot Abadeh thick, marked by a small star (*) on Map 3, seems to match the 7,000 foot Hormoz thick (small star) on the opposite side of the Main Zagros Fault 465 kilometers distant, implying 465 Kilometers of left- lateral offset.

3. The 4,000 foot Khaneh Kat thick, marked by a large star (*) on the Persian Gulf side of the Main Zagros Fault, appears to match the 4,000 foot Arak thick (large star) on the other side of the fault, again with an approximately 465 kilometer left-lateral offset implied.

4. If this 465 kilometer horizontal displacement along the Main Zagros Fault is removed, as shown in the palinspastic reconstruction of Map 5, the several isopach thins and thicks under discussion can be joined across the fault with a reasonably good match in each case (big star opposite big star, and little star opposite little star, etc.)

5. Although much of the Permian (usually all of the Upper Permian) is composed of dolomite, anhydrite and limestone, the Khaneh Kat and Arak Thicks are Known to contain largely sandstone, redbeds, and some volcanics (Edgell, 1977, and Koop and Stoneley, 1982); so in some cases facies evidence also tends to lend support to the evidence of matching isopach trends on Map 5. More information is needed in the Abadeh and Hormoz thicks to determine if, in these two areas, similar matching facies exist. Information in northwestern Iran and eastern Turkey is inadequate at this stage to look for such evidence of large scale horizontal displacements.

6. Husseini (1988), quoting Brown and Jackson, and Moore and Alshanti, describes up to 300 kilometers of pre-Cambrian left lateral displacement on the Najd Fault System, shown on Map 1. Agar (1987) describes the major Najd wrench fault system (within the pre-Cambrian Arabian Shield), which strikes almost exactly

distribution of "pre-Khuff Clastics" or Unayzah Formation (Saudi Aramco terminology).These strata are interpreted to be in large part transgressive marine (not always shallow marine) clastics overlying a widespread Hercynian Unconformity surface. Glacial deposits are important in parts of Oman and the Rub Al Khali in southeastern Saudi Arabia and Abu Dhabi.

This map shows up to 4,000 feet or more of Carboniferous clastics, which more or less fits the "Tabuk Basin" description of Saudi Aramco, in Arabian outcrop areas, trending almost exactly in a northward direction beneath the previously defined Mesozoic Mosul-Ga'ara-Jauf Arch. So here we have a good example of a regional stratigraphic/tectonic inversion. Reviewing the isopach maps of this study in connection with the tectonic elements described by Laboun (1987 and 1988) it seems evident that Laboun's Tabuk Basin is a pre- Permian development, whereas his Widyan Basin is Permian and younger (more or less a part of the regional Middle East or Mesopotamian "Mesozoic" Basin). That makes the inter vening "Hail- Rutbah Arch" a strange animal with spots on one side and stripes on the other.

In spite of the limited deep well data currently at hand, isopach contours of Permo-Carboniferous clastics in Iraq, Kuwait and Saudi Arabia are nevertheless drawn to illustrate the previously mentioned hypothesis that the Kuwait Arch is a subsurface continuation of the Central Arabian Arch at deep (Paleozoic and pre- Cambrian) levels. The limited outcrop and well data quoted by Laboun (1986, 1987, 1988) plus other published thickness figures are consistent with the interpreted north trending series of highs and lows drawn on Map 4 (Kuwait- Central Arabian Arch, Ghawar Trend, Qatar Arch-Kuh-e Dinar Thin and Abu Dhabi-Kaneh Kat Thick).

Tertiary to Recent Lateral Movement Along the Zagros Fault

The Main Zagros Fault shown on the accompanying maps trends north- westerly through western Iran, eastern Iraq, and southeastern Turkey. It has been described variously as a thrust zone, subduction zone, transform fault or suture, etc.

During the first half of this century, the Main Zagros Fault was usually mapped as a discontinuous or even major thrust fault, or "crush zone", separating the complex, often structurally high, blocks of Central Iran from the Zagros Mountains Fold Belt and Foothills Belt of coastal Iran. Later, during the 1960's it became fashionable to treat the Zagros in terms of continental plate collisions, subduction, breakup and recollisions, and the term "Suture" came into vogue (see Kashfi, 1985, 1988).

More recently (late 1960,s to early 1970,s) a number of Tertiary to Recent right-lateral strike slip characteristics of the Zagros Fault came to be recognized by structural geologists doing field work in Iran. By 1974 field geologic observations led to the conclusion that some tens of kilometers (probably 60 Kilometers) of dextral slip had occurred during Tertiary to Recent time. And by 1988 the quantitative calculations of earthquake seismology had documented in convincing ways fairly consistent dextral offsets along the North Anatolian- Zagros Fault System and sinistral offsets along the East Anatolian and Dead Sea Faults (see Map 1).

This evolution in tectonic thought did not progress uniformly, but was erratic, discontinuous, and not without occasional atavistic reversals. A review of several interesting stages in this process leads to the currently accepted right-lateral(and thrust) nature of the Main Zagros Fault, since late Cretaceous-Tertiary time.

A final conclusion will discuss what seems to the writer to be growing bits of evidence that much earlie (Paleozoic-early Mesozoic?) lateral movement may have been in the opposite direction (that is left- lateral, rather than right- lateral).

Wellman (1966), in an otherwise bizarre article which speaks of tectonic spirals and central forces, interprets regional air photo mosaics in three areas to show right-lateral stream offsets and other displaced features of geomorphological character along the Zagros Fault trend. He did not consider the right- lateral evidence to be conclusive, but quotes Pavoni (1961) to indicate the Zagros to be an extension of the North Anatolian Fault, previously considered to be right- lateral in character.

Stocklin,s 1968 narrative on the structural history of Iran seemed to be interested in almost everything else, but not in strike slip shear.

Falcon (1969) referred to the relative straightness of the Zagros Thrust, which in itself would suggest a basement discontinuity with a probable strike slip component of movement, and indicated dextral slip on the Kazerun fault line (29N, 51E). Since this fault seems to be oriented in a conjugate shear position with respect to the Main Zagros Fault, it suggests left-lateral displacement on the main Zagros Fault. Stocklin (1974) also commented on the conspicuously straight alignment of the "Zagros Thrust" and suggested that the presence locally of two or more parallel thrust lines, of steeper and shallower dip, merely indicate the "reactivation of a much older rift" with "a right- lateral component of unknown magnitude."

As recently as 1971 Braud and Ricou were focusing in large part on whether the Zagros Main Fault was a thrust or a wrench fault, or both, but Haynes and McQuillan (1974), in their discussion of the Zagros Suture, emphasized thrust component, continental drift, collision, subduction, colored melange, and covered every thickness of about 5,000 feet of Triassic sediments in a linear regional low trending northward from Riyadh through Baghdad. Roughly parallel thins lie to the west ("Mosul- Ga'ara- Jauf Arch") and to the east (Kuwait Arch). Isopach patterns show the Kuwait Arch thin extending northward into coastal Iran as a prominent high which separates the Dezful Thick from the Lurestan deep basinal area.

Thin axes also pass northward through the Qatar Arch and apparently just east of the Ghawar Trend (Na'lan Trend?).The Qatar Arch thin clearly projects across the Persian Gulf into the prominent Fars- Shiraz thin in Iran. The Na'lan Trend may extend as a thin axis northward through Qatif toward the offshore Maharah and Lulu structures. Better isopach control is needed in these areas. East of the Qatar Arch lie major thick deposits of the Rub Al Khali Basin and the Darab and Kuh-e Gahkum or Hormuz thicks of southeastern Iran,but here the north- south parallelism of previously mentioned highs and lows is no longer maintained.

In eastern Syria, western Iraq and northern Saudi Arabia another nearly parallel Triassic thin trend has been named the Mosul-Ga'ara-Jauf Arch or Hail- Jauf- Rutbah-Mosul Trend by various authors. The "Hail- Rutbah" segment is not a Triassic development at all, but rather a northwesterly trending middle Cretaceous and younger eroded uplift.

In northern Syria, northern Iraq, and southeastern Turkey a very differently oriented depocenter, partially equated with the Palmyra Zone in Syria, is located south to the left- lateral Bakuk and Jabal Abd El Aziz faults. Triassic, and for that matter, younger evaporites occur in what is clearly a separate rift basin or sub-basin of more or less east- west strike, extending eastward across the Iraq border through the Jebel Sinjar area. Miocene Fars Formation evaporites are still thick at Sinjar (Youash, 1970) so the classic structural inversion folding which created the Sinjar Anticline is very young (Pliocene to Recent).

An unrelated local northwesterly trend in the Triassic isopach contours of Map 2 is observed in the Khuzestan/Kuh-e Barun Pir area of Iran (31 N,51 E). This is due to a subsequent pre-Jurassic or mid-Jurassic unconformity (Dopolan area of Koop and Stoneley).

Upper Permian Depositional Trends

Upper permian strata are regionally shelf carbonates, for the most part, with very minor anhydrite and shale interbeds. Exceptions to this are shalier basinward strata, and, along the Zagros Main Fault, some rather atypical coarse clastics (turbidites?) and volcanically derived deposits have been described.

Map 3 shows regional Middle East isopachs of the Upper Permian (Khuff Formation in Saudi Arabia, Qatar, Abu Dhabi,and other equivalent stratigraphic units northeast and northwest of the Persian Gulf).Where deep tests in producing fields have fully penetrated the Upper Permian,average thicknesses are often around 2,000 feet.Usual lithologies include limestone, dolomite and thin interbeds of anhydrite.Gradual thinning and truncation takes place in an up-dip westward direction against the Mosul-Ga'ara-Jauf Arch in western Iraq and northwestern Saudi Arabia.

Within Saudi Arabia and the Emirates there are two major thin north- trending ridges covered by only about 1,000 feet, or approximately half the usual Permian thickness. One is the Qatar Arch-Kuh-e Dinar Trend. The other is the Kuwait Arch, which goes through the Burgan Oil Field. At Burgan thin Permian directly overlies basement rocks in some deep wells. Subsurface information is currently inadequate, but the Kuwait Arch (as a Paleozoic and pre-Cambrian ridge) is tentatively interpreted to be a deep north- south subsurface extension of the surface outcrop structure Known as the Central Arabian Arch. However, younger expression of the Central Arabian Arch has been shown in earlier publications as an eastward plunging regional arch in Mesozoic and Tertiary rocks, as in Map 1, which merely copies most of the trends identified by Laboun, 1988.

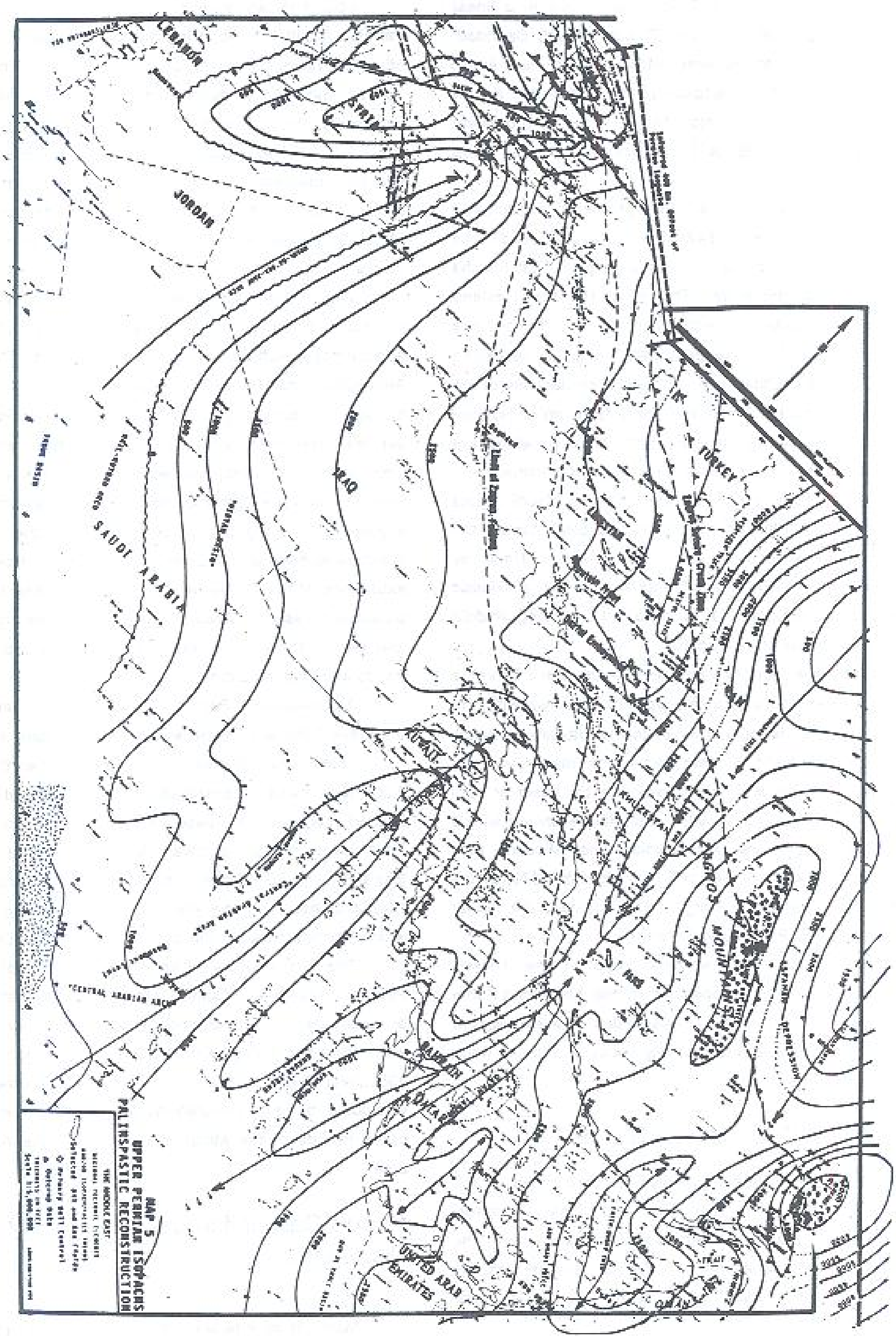
A possible third Permian thin or ridge (the Fateh-Dubai Thin) the Kuh-e Nakh and Darash areas of southeastern Iran.

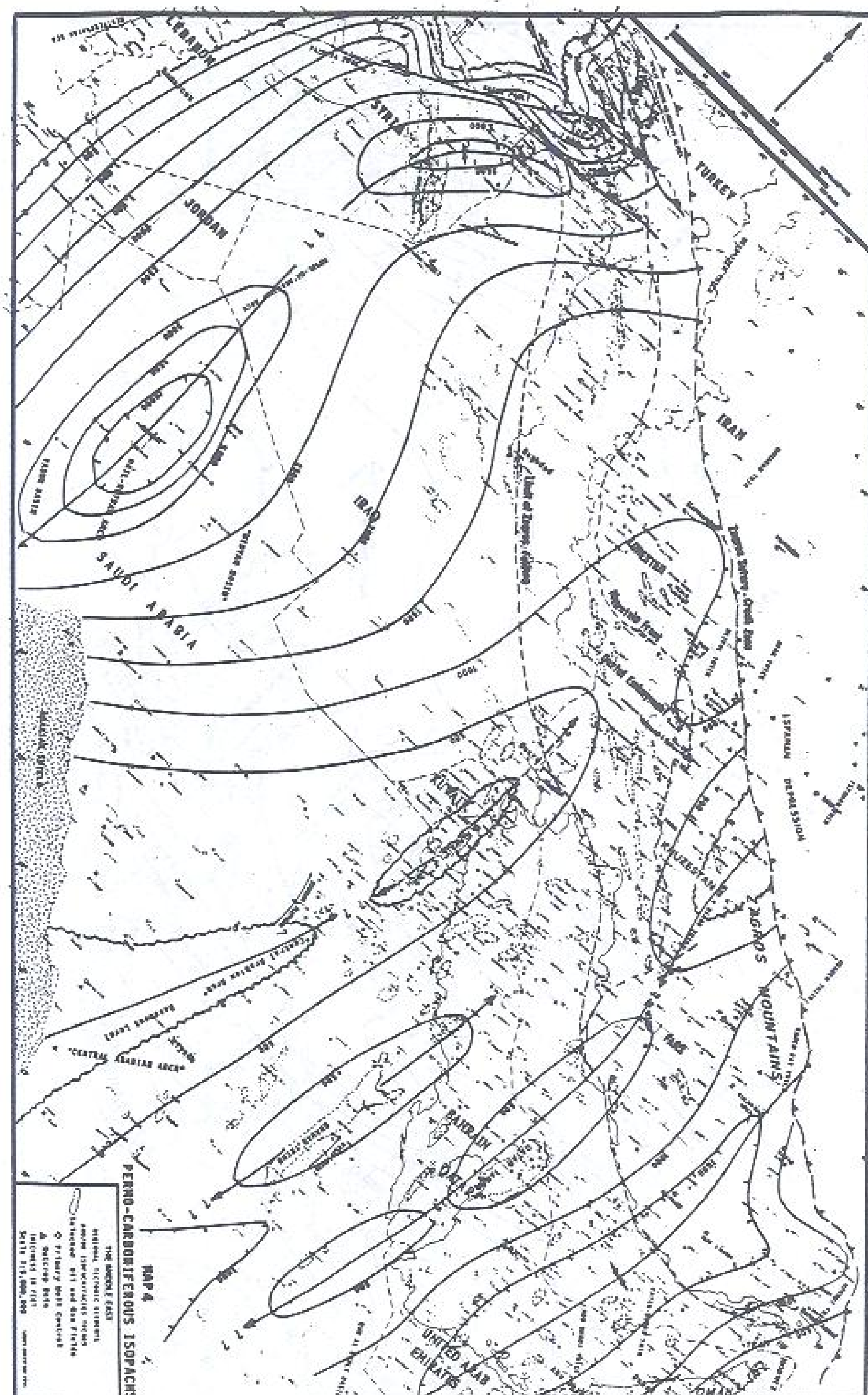
Looking next at Permian thick, rather than thin, trends, two 4,000 foot thicks (approximately twice the usual thickness) are located in coastal Iran. These are identified on Map 3 as the Dezful Thick, which trends southward across the Persian Gulf more or less between and parallel to the previously mentioned Qatar and Kuwait arches, and the Kaneh-Kat Thick, in southeastern Iran, which trends across the Persian Gulf into the Abu Dhabi Thick.

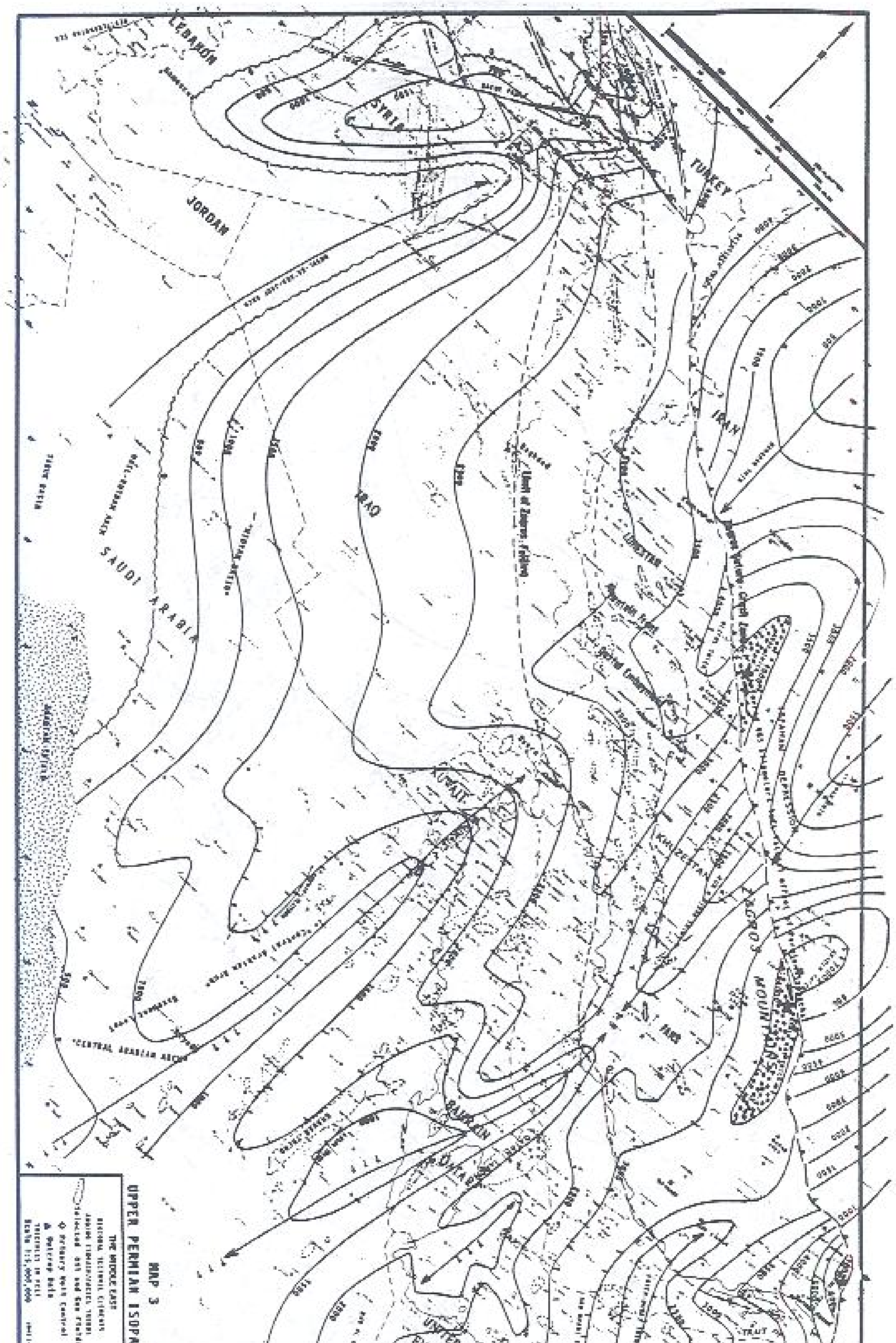
The most unusual thickness of Permian (not entirely Upper Permian)sediments in Coastal Iran is the 7,000 feet or more (triple or quadruple the "normal" thickness) present in the Hormuz Thick, within the Kuh Faragh-Kuh Gahkum area (Koop and Stoneley, 1982),near Bandar- Abbas. An equally great thickness of Permian was noted, but not contoured, by koop and Stoneley (1982) on the opposite side of the Main Zagros Fault in the Abadeh outcrop area.

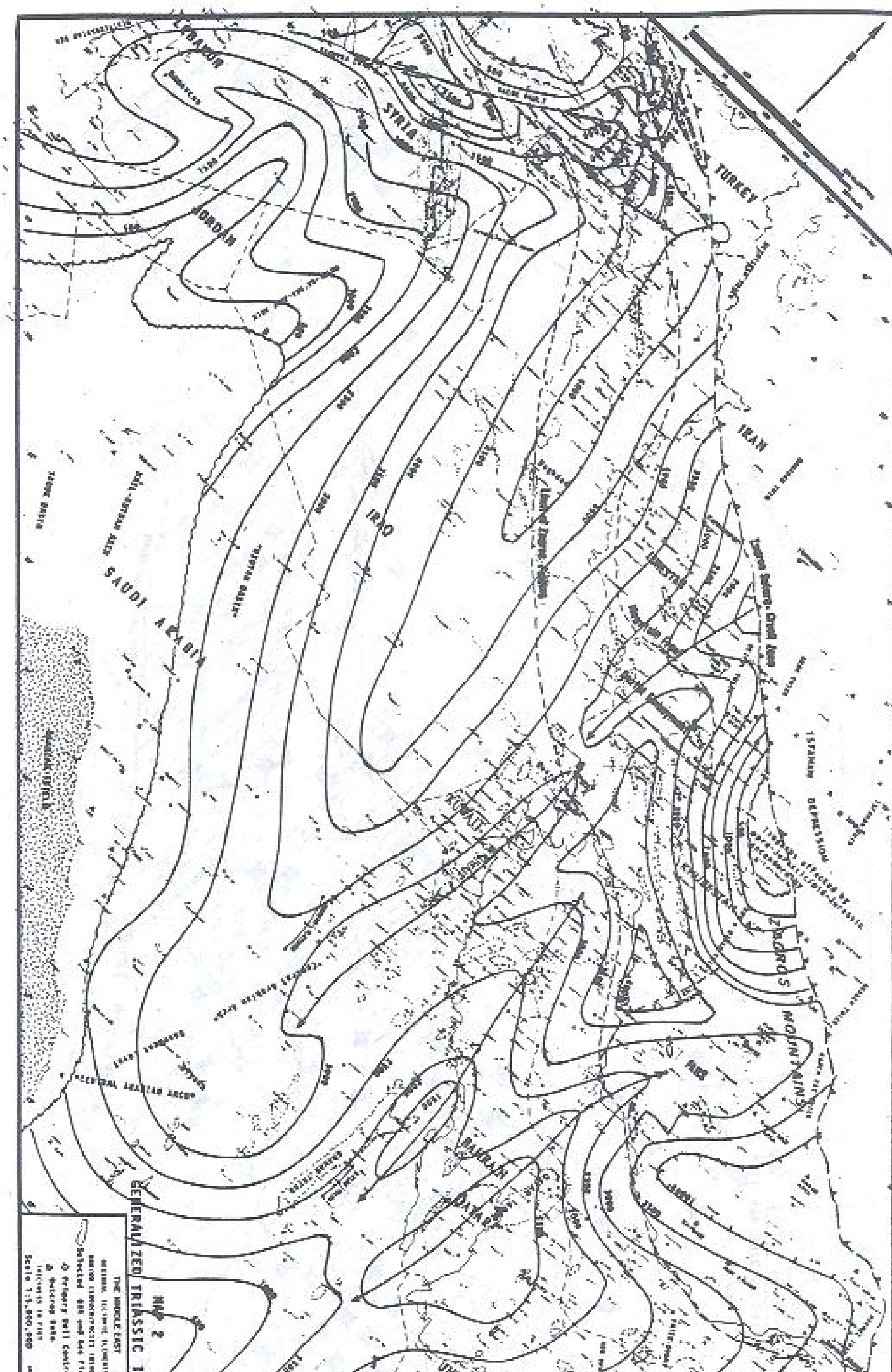
Permo-Carboniferous Sedimentary Distribution

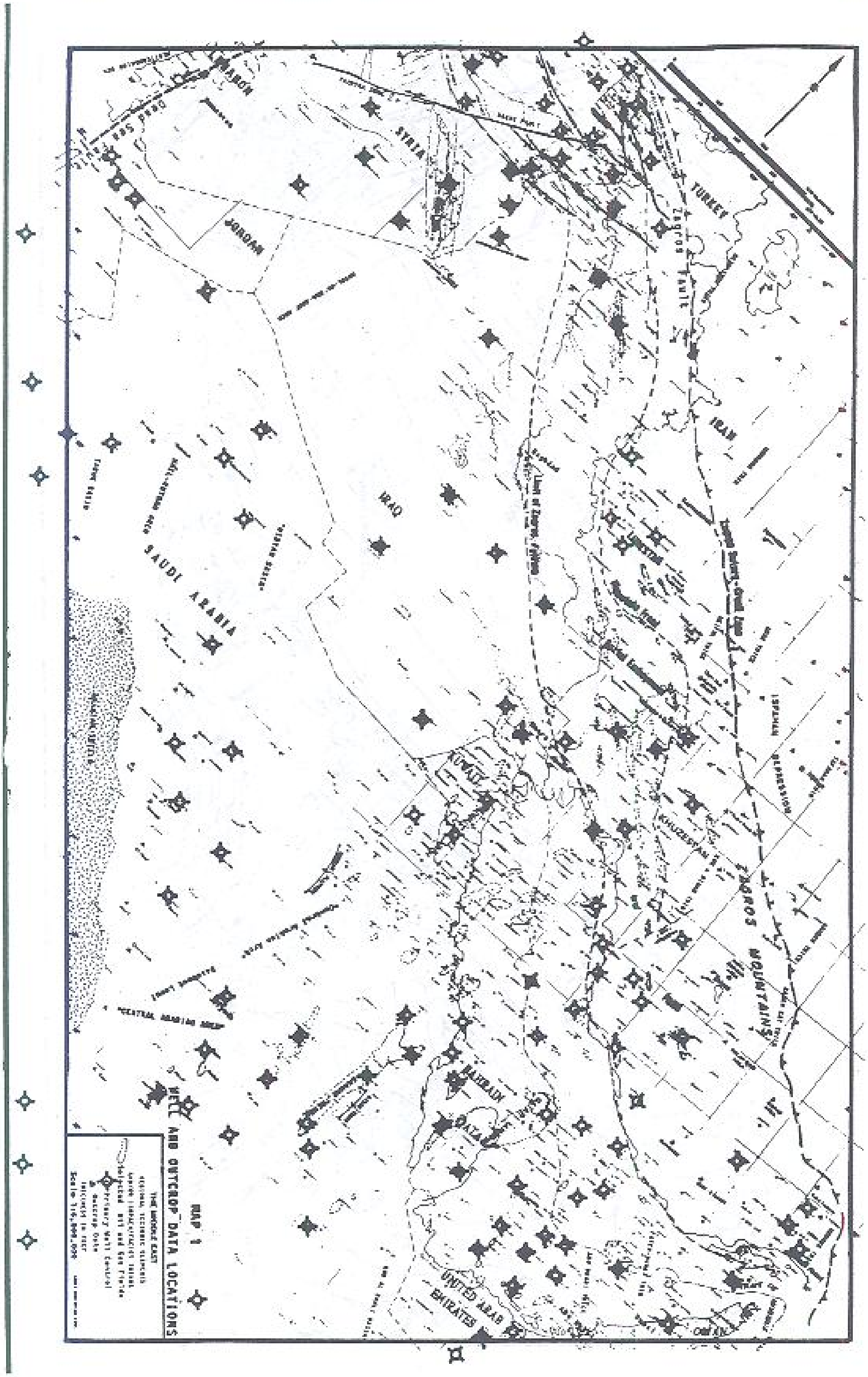
Map 4 is an interpretation of Permo-Carboniferous isopach


MAP 5
UPPER PERMIAN ISOPACHS
PALINSPASTIC RECONSTRUCTION
THE MIDDLE EAST
LEBANON
SYRIA
JORDAN
IRAQ
SAUDI ARABIA
TURKEY
KUWAIT
BAHRAIN
QATAR
UNITED ARAB EMIRATES
CENTRAL ARABIAN ARCH


MAP 4
PERMO-CARBONIFEROUS ISOPACHS
LEBANON
SYRIA
JORDAN
TURKEY
IRAN
IRAQ
SAUDI ARABIA
KUWAIT
BAHRAIN
QATAR
UNITED ARAB EMIRATES
OMAN
KHUZESTAN
FARS
ZAGROS MOUNTAINS
"CENTRAL ARABIAN ARCH"


MAP 3
UPPER PERMIAN ISOPACHS
THE MIDDLE EAST
LEBANON
SYRIA
JORDAN
TURKEY
IRAQ
IRAN
SAUDI ARABIA
KUWAIT
BAHRAIN
QATAR
UNITED ARAB EMIRATES
OMAN
LURISTAN
KHUZESTAN
FARS
ZAGROS MOUNTAINS


MAP 2
GENERALIZED TRIASSIC ISOPACHS
THE MIDDLE EAST
LEBANON
SYRIA
TURKEY
JORDAN
IRAQ
IRAN
SAUDI ARABIA
KUWAIT
BAHRAIN
QATAR
UNITED ARAB EMIRATES
OMAN
ZAGROS MOUNTAINS
ISFAHAN DEPRESSION
CENTRAL ARABIAN ARCH


MAP 1
WELL AND OUTCROP DATA LOCATIONS
THE MIDDLE EAST
LEBANON
SYRIA
JORDAN
TURKEY
IRAQ
IRAN
SAUDI ARABIA
KUWAIT
KHUZESTAN
ZAGROS MOUNTAINS
BAHRAIN
QATAR
UNITED ARAB EMIRATES

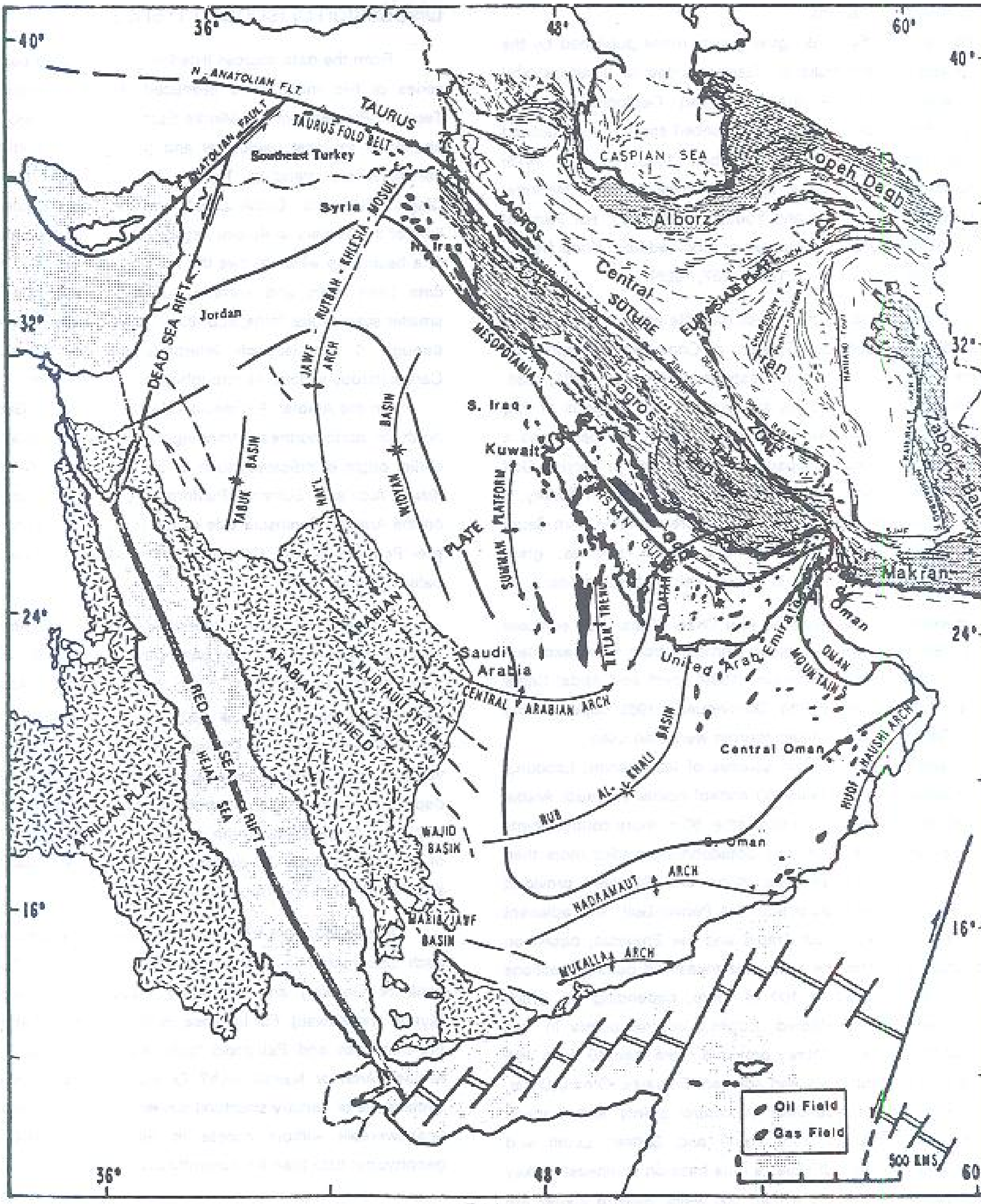


FIGURE 2
REGIONAL TECTONIC ELEMENTS
(AFTER AL-LABOUN, 1988, WITH MODIFICATIONS BASED ON BERBERIAN AND KING, 1980, ALSHARHAN AND KENDALL, 1986, AND BRINKMAN, 1976)

and industrial scout reports.

For Iraq and Syria, Bouguer gravity maps published by the Russians and others (Ponikarov, Kassler, Buday, M. J. Abbas) and surface and subsurface maps by Iraq Geological Society, University of Baghdad, and other referenced sources were utilized (Al Rawi, 1981; Wolfart, 1981; Weber, 1963; Al Ani, 1975; Spaargaren, 1987; Metwalli, et al, 1974; Lovelock, 1984; McBride, et al, 1990; Ibrahim, 1983; and Youash, 1970; etc.). For Parts of Iraq isopach contours were adapted or modified from Koop (1982), Bishlawy (1985), and Laboun (1986, 1987, 1988).

A personally held Turkish well data file and Bouguer gravity compilaiton for southeast Turkey, a Consultant,s Report by Christian (1991), and several publications by Beydoun (1981, 1988, 1989) covering Lebanon, Syria and Jordan, plus portions of Iraq data and maps included in earlier mentioned references made it possible to draw sketchy isopach contours from the Persian Gulf region northward through Iraq, Syria and southeastern Turkey. If detailed well data and geophysical data were available from Saudi Aramco, Iraq National Oil Co., and Iranian sources, great improvements could be made in the accuracy of these maps.

Isopachs and well data on Abu Dhabi, Qatar and adjacent offshore field areas were obtained primarily from three excellent papers by Loutfi and El- Bishlawy (1989),Loutfi and Abdel Sattar (1987) and El Bishlawy (1985). Dominguez,s 1965 paper on the Offshore Qatar Fields and other sources were also used.

To summarize the main sources of information, Laboun,s works provided approximately 50 control points in Saudi Arabia (wells and outcrop sections) and another 50 or more control points in other nearby countries. In Iran, Setudehnia provided more than 30 wells and outcrop sections; Koop and Stoneley provided regional isopachs for coastal Iran, the PersianGulf, and adjacent parts of Iraq, Kuwait, Saudi Arabia and the Emirates, based on both onshore and offshore wells and measured outcrop sections numbering perhaps 50 to 100 or more, depending on which isopach interval is considered. Edgell,s control points in Iran exceed 30 in number. Bishlawy provided more than 40 deep well control points for Abu Dhabi and adjacent Emirates, Oman, Qatar, Bahrain, etc. Similar quantities of control points and isopach contours were obtained from Loutfi and Sattrar, Loutfi and Bishlawy, and Husseini. Christian,s data base on southeast Turkey includes information on more than 500 wells. Sincere thanks are due Professor E. M. Nairn of the University of S. Carolina for his encouragement and valuable editorial suggestions.

Discussion of Isopach Trends

From the data sources listed in the preceding paragraphs, a series of five maps were produced. Figure 2 shows regional Tectonic Elements of the Middle East as well as major Oil fields, and other regional geological and geographical features. Major northwestward trending Tertiary to Recent tectonic features (Zagros Suture or "Crush Zone", and the approximate westward limit of the Tertiary to Recent Zagros folding) are indicated on Map 1, a base map which shows the location of published stratigrahic data from wells and surface outcrops. Numerous somewhat smaller scale faults, folds, sub- basin axes are also shown. Maps 2 through 5 are isopach interpretations of Triassic through Carboniferous sediments throughout the Middle East.

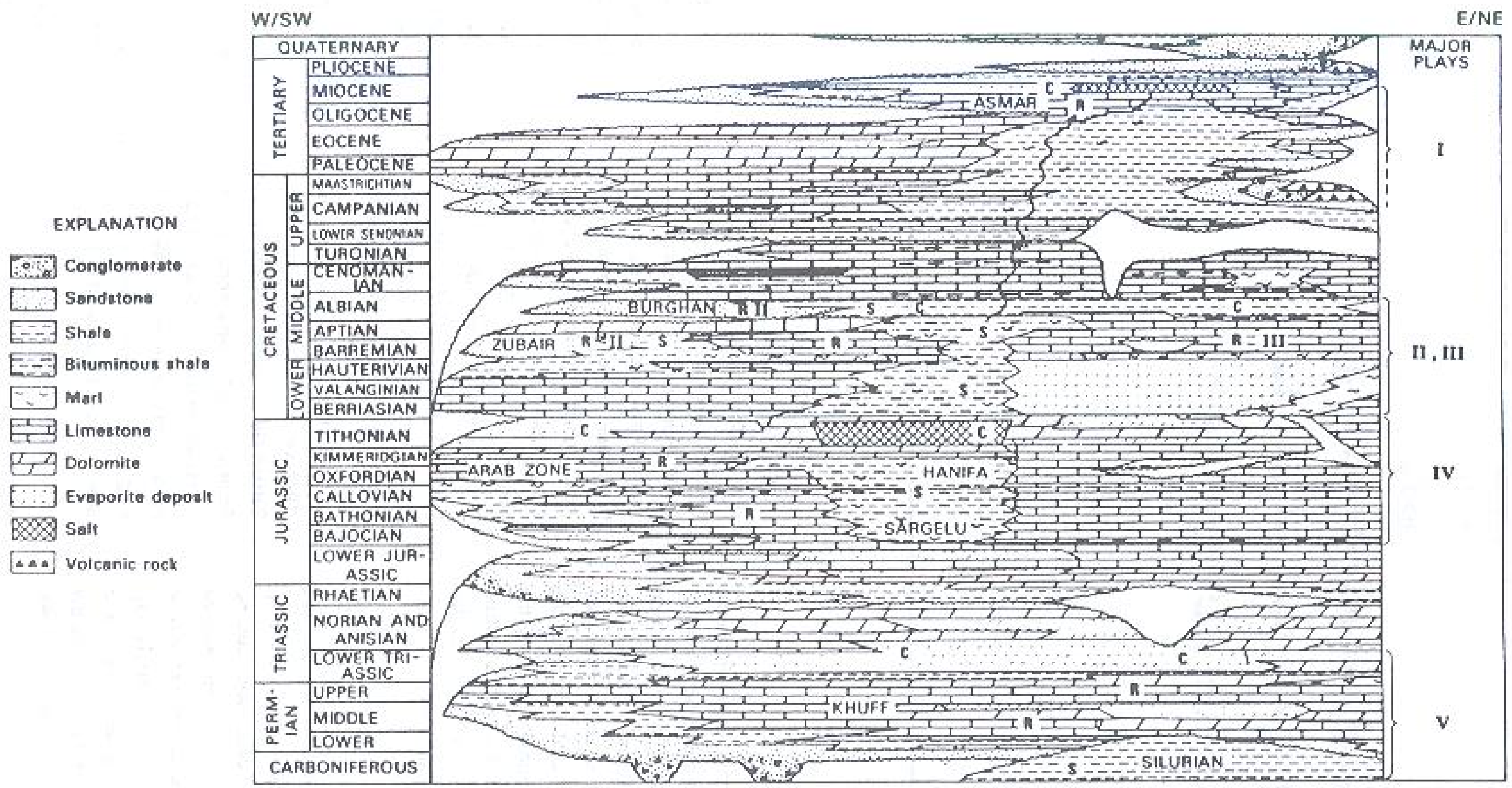
On the Arabian Peninsula side of the Persian Gulf, a nearly north or north-northeast trending family of structural trends of earlier origin is indicated, such as the Qatar Arch, Ghawar Trend, Kuwait Arch and "Summan Platform". These older structural trends on the Arabian Peninsula side of the Persian Gulf probably follow pre- Permian or pre- Carboniferous lines of deformation and/or paleotopography.

Some of the features identified, such as the Ghawar Trend and Qatar Arch, are primarily descriptive of structure. Certain other terms on the isopach maps (Maps 2-5), such as the Abadeh Thick and Isfahan Thin, are more descriptive of sedimentary character than of specific structure. Obviously some mapped trends relate to younger and some to older geologic periods of development, depending on the nature of stratigraphic inversions, and so not all of the trends identified on the isopachs are appropriate to all three of the isopach maps (Triassic on Map 2, Upper Permian on Map 3, and Permo- Carboniferous Clastics on Map 4).

It is uncertain exactly what meanings are to be conveyed by such Saudi Aramco-named feaures as the "Na'lan Trend" (east flank of Ghawar) and "Summan Platform" (midway between Riyadh and Kuwait). For instance, is the Summan Platform an old pre-Cambrian and Paleozoic high related either to the Central Arabian Arch or Kuwait Arch? Or does it refer to a late stage Cretaceous or Tertiary structural development? Such questions are unanswerable without access to more Saudi well data and geophysical data than are currently available.

Regional Distribution Of Triassic Sediments

Middle East Triassic sediments are predominately Carbonates, evaporites, and lesser shales. Minor coarse clastics occur locally in rifted sub- basins. Map 2 shows a maximum



Generalized stratigraphy of Arabian-Iranian basin showing position of five major plays (Roman numerals I-V) and their associated reservoir rock (R), cap rock (C), and source rock (S). Note source rock for play V is Cretaceous and Jurassic. (Modified from Murris, 1980, p. 598.)

(After Masters et al, 1982)

FIGURE 1.

GENERALIZED MIDDLE EAST STRATIGRAPHY

تصویر روند خطوط هم‌ستبرای تریاس، پرمین و کربونیفر از عربستان- سراسر خلیج‌فارس - به سوی ایران و پیشنهاد جابه‌جایی چپبر زمان پرمین در راستای ابرگسله زاگرس

نوشته: لوییس کریستین *

Introduction

Triassic, Permian, Carboniferous and older Paleozoic sedimentary rocks have in recent years been drilled fairly often by deep wells in the Middle East. To the extent that Paleozoic outcrop data, isopach maps, and deep well data have been published for the region in recent years, it has become possible to compile Triassic, Permian and Carboniferous isopach units throughout the region, to correlate isopach trends on opposite sides of the Persian Gulf, and even to attempt a correlation of possibly offset Permian isopach trends on opposite sides of the Main Zagros Fault, or "Zagros Suture" (Haynes and Mc Quillan, 1974).

Available Data

A good starting point for this study was the 1986, 1987 and 1988 work of Abdulaziz Abdullah al-Laboun (see references). Structural elements, isopach maps, well data, and outcrop measured sections published by Aramco or former Aramco personnel provided considerable subsurface control not only in Saudi Arabia but also in Iraq, Iran, Jordan, Syria and Turkey. Besides the Laboun data, significant Saudi data were also obtained from Aramco contributions to the Arabian Schlumberger Well Evaluation Conference (1975), the work of Husseini (1988, 1991) and others.

Other stratigraphic and structural data were obtained from U.S.Geological Survey Professional paper 560- D (1966, by Powers et al), Tectonic map of the Arabian Peninsula (Brown, 1972), and various Oil and Gas Journal and other press reports, especially of recent Paleozoic oil discoveries in Saudi Arabia, Jordan and Turkey. Base map, structural elements, measured sections, well thicknesses, major fault lines and selected prominent oil fields were adapted from Alsharhan and Kendall (1988), and the several Saudi publications cited above, and similar data for non- Saudi areas of the Middle East from Berberian and King (1981), Brinkman (1976), Koop and Stoneley (1982), Bishlawy (1985), Loutfi et al (1970,1987), Setudehina (1978), Edgell (1977), Ponikarov et al (1967), Buday, et al (1980, 1987), Rigo de Righi and Cortesini (1964), Lovelock (1984) and Christian (1991).

An excellent Iranian data source was found in Edgell (1977),very useful isopach maps extending from Iran across the Persian Gulf to parts of Arabia and Iraq were found in Koop and Stoneley (1982). Setudehnia (1978) provided useful isopachs, measured sections, and well data for southwestern Iran. Other Iranian data of a general nature were obtained from Berberian and King (1981), Bordenave and Burwood (1990), and the Schlumberger Iranian Well Evaluation Conference (1976).

For Kuwait, reference was made to Bou- Rabee (1986), Warsi (1990), Loutfi and Jaber (1970) and miscellaneous press

Projection of Triassic, Permian, and Carboniferous Isopach Trends from Arabia Across the Persian Gulf into Iran, and Proposed Sinistral Displacement of Permian Isopachs along the main Zagros Fault.

By: Louis Christian *

Abstract

Isopach trends (thins and thicks) have been compiled for the Triassic, Upper Permian Khuff Formation (and equivalents) and Permo-Carboniferous clastics throughout most of the Middle East (Figure 1). Isopach trends in the Arabian Peninsula can be projected across the Persian Gulf into coastal Iran with some confidence. Across the main Zagros Fault or Zagros Suture a different kind of isopach pattern is observed, inconsistent with isopach trends on the Persian Gulf side of the fault zone.

In a palinspastic reconstruction, if about 465 Kilometers of sinistral offset of the Permian along the Main Zagros Fault is assumed, then Permian sediments on both sides of the fault can be shown to be compatible in thickness and facies trends. This inferred left- lateral offset is counter to the apparent direction of late Tertiary to Recent strike slip offset as generally accepted (Beydoun, 1989, and many others).

چکیده

در این بررسی تلفیقی از خطوط هم‌ستبرا (نازک وستبر) در تریاس، سازند خاف پرمین بالا و پرمو- کربونیفر در سراسر خاورمیانه صورت گرفته است (شکل ۱). خطوط هم‌ستبرا در شبه‌جزیره عربستان می‌تواند به سوی سواحل ایران با دقت بالایی نشان داده شود این خطوط از این سو به آن سوی ابرگسله زاگرس یا زمیندرز زاگرس، با داده‌های موجود از خطوط هم‌ستبرا در گستره خلیج‌فارس سازگاری ندارد.

برپایه نقشه‌هایی که ویژه‌گی‌های جغرافیایی لایه‌های چین‌خورده و گسلیده را پس از بازسازی دوباره (Palinspastic map) نشان می‌دهند، با درنظر گرفتن نزدیک ٤٦٥ کیلومتر جابه‌جایی چپبر پرمین در راستای ابرگسله زاگرس، رسوبات پرمین دوسوی گسله از دیدگاه ستبرا و روند رخساره‌ها مطابقت خواهند داشت.

جابه‌جایی چپبر پیشنهادی، در تضاد با دیدگاه‌های موجود در زمینه حرکت راستالغزی است که از ترسیر پسین تا عهدحاضر در گستره زاگرس پیشنهاد شده است (Beydoun 1989 وبسیاری از دیگر پژوهشگران).