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Provenance of the Hinglaj formation in southern Balochistan

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ABSTRACT: *Miocene-Pliocene Hinglaj Formation is widely exposed in southern Balochistan. For current study of provenance investigation, samples have been collected from Nal and Bela area. The percentages of the frame work grains have been deduced from point counting using the standard method. All the encountered frame work constituents were counted and intergranular fine grained quartz was treated as matrix. The point counting results represent the volume of the original grains.*

The petrographic analyses of mostly medium to coarse grained, moderately to well sorted samples indicate that the maximum percentages of frame-work grains are upto 88 % monocrystalline quartz, 15 % polycrystalline quartz, 13 % chert, 8 % plagioclase feldspar, 3 % potash feldspar, 24 % sedimentary rock fragments, 17 % volcanic rock fragments, 2 % biotite, 3 % muscovite, 2 % heavy minerals including zircon, hornblende, sphene, rutile, epidote, 17 % opaque minerals, 8 % shell fragments, 35 % algae fragments and 17 % microfossils.

The point counting data, when plotted in the QFL, QmPK, QmFLt, and QpLvLs ternary diagrams indicate Recycled Orogen Provenance. On the basis of the petrographic results, geological history of the region since early Miocene lasting to the present day and interpretation of the previous workers, it can be concluded with reasonable confidence that the Hinglaj Formation has a mixed provenance. The major detritus was derived from the Himalayan Crystalline Belt and minor volcanic content was incorporated from Chagai Magmatic Arc.

INTRODUCTION

Provenance interpretation based on petrofacies analysis is still a generally acceptable method for establishing the complex relationship between paleotectonics and paleoclimates. Although the weathering and transport processes extensively alter the original signatures of the provenance, however some imprints of provenance are still preserved in the final sedimentary products even in the beach sediments. Such imprints have been widely used for paleotectonic and paleoclimate interpretation (Potter 1984 & 1986). Keeping in view the aforesaid statement, previously untouched aspect of provenance of the Hinglaj Formation has been investigated. Thick sequences of Miocene-Pliocene siliciclastic rocks are extensively exposed all along the Makran coast. These rocks have been designated as Hinglaj Formation (East of Ormara) and Talar Formation (West of Ormara) by (HSC) Hunting Survey Corporation (1960). The studied sections lie along the eastern side of Ornach-Nal Fault which border the Hinglaj complex in the east (Fig 1). Shah (1977) has summarized the age of the Hinglaj Formation in the Axial Belt and Balochistan Basin as middle Late Oligocene - Pliestocene and Miocene - Pliocene respectively. Table 1 shows the generalized stratigraphic succession of the area. The formation is transitionally and conformably underlain by Haro Conglomerate in the Bela area, whereas in the Nal area the upper contact is not exposed. The lower contact of the formation is also transitional with Nal Limestone and Parkini Mudstone in Nal and Bela areas respectively. The Parkini Mudstone is partly equivalent to Nal Limestone (HSC, 1960).

TABLE 1. GENERALIZED STRATIGRAPHIC SUCCESSION OF THE AREA

Age	Formation	Lithology	Reference
Pleistocene	Haro Conglomerate	Mostly clasts of Hinglaj Formation with minor sandstone and siltstone	HSC (1960)
Miocene to Pliocene	Hinglaj Formation	Khaki brown, rusty, whitish to greyish green sandstone, mostly unconsolidated, coquinoid to argillaceous with subordinate greyish green shale.	HSC (1960)
Late Oligocene to Early Miocene	Nal Limestone	Mostly yellowish white to pinkish limestone with subordinate sandstone like that of Hinglaj Formation and khaki brown sandy to silty shale.	HSC (1960)
		Erosional Unconformity	HSC (1960)
Late Paleocene	Wad Limestone	Brecciated to bedded limestone, sugary yellowish brown sandstone and white chalky marl.	HSC (1960)
Late Cretaceous to Paleocene	Thar Formation	Dark green sandstone, mostly maroon calcareous shale, nodular marl, pebbly and brecciated volcanic rock fragments and basaltic lava flow.	HSC (1960)
	Pab Sandstone	White cream or brown thick bedded to massive quartzose sandstone with subordinate shale and limestone.	HSC (1960)
Cretaceous	Bela Ophiolites	Pillow basalts & breccia, massive flow, diabassic and gabbroic sills and melange with clasts of variable composition.	Sarwar (1992) Gnos et al. (1998)
	Parh Limestone	White or cream coloured, bedded, porcellanous limestone.	Shah (1977)
	Goru Formation	Thin bedded limestone with subordinate shale (usually maroon coloured)	Shah (1977)
	Sembar Formation	Black to greenish shale with siltstone, nodular and argillaceous limestone.	Shah (1977)
	Anjira Formation	Dark grey, fossiliferous, thin to thick bedded limestone with subordinate partings of marl and calcareous shale.	Anwar et al. (1992)
Upper Triassic to Middle Jurassic	Malikhore Formation	Greyish thick bedded to massive and shelly limestone with subordinate calcareous shale and marl.	Anwar et al. (1992)
	Kharrari Formation	Grey to brownish Grey, thin bedded, flaggy, micritic and unfossiliferous limestone. Grey to light grey, medium bedded quartzose sandstone and subordinate siltstone & shale.	Anwar et al. (1992)

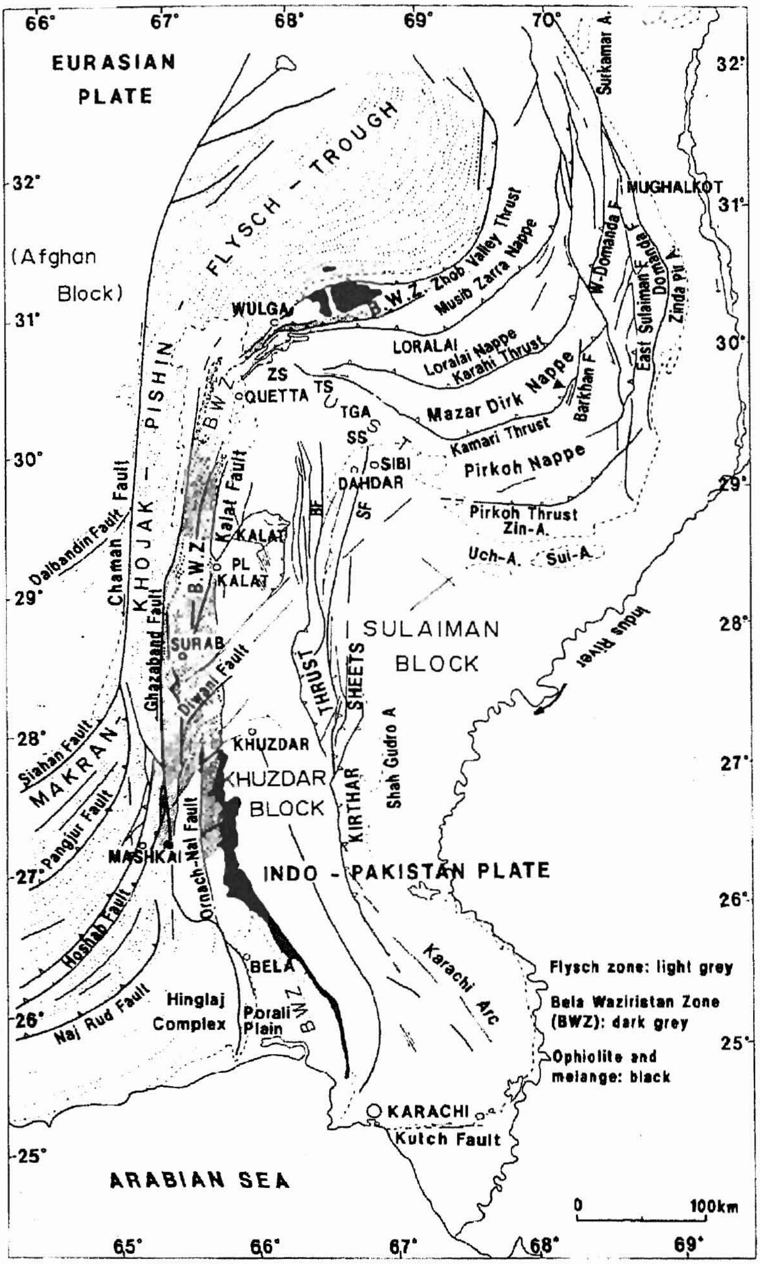


Fig. 1. Dominant structures in the Balochistan Basin, Kirther Foldbelt and Sulaiman Foldbelt of Pakistan (After Bannert et al.1992). Stars delineate the location of the studied sections. A: Anticline; BF: Bolan Fault; BWZ: Bela-Waziristan Ophiolite Zone; SF: Sanni Fault; SS: Sangan Syncline; TGA: Tor Ghar Anticline; TS: Timur Syncline; UST: Urak Sibi Trough; ZS: Zarghoon Syncline.

The Hinglaj Formation is heterolithic in composition as the sandstone, shale and shale with inter-bedded sandstone are the dominant lithologies. The studied Nal section (Fig 2) which is 1443m thick shows no cyclic deposition of facies and reflects abrupt facies variation over short vertical distance. The mineralogically mature, medium to fine grained, 5-35 m thick sandstone horizons which are mostly trough cross-bedded, low angle cross-bedded, planner cross-bedded with minor hummocky cross-bedding, comprise the significant sandstone proportion. This sandstone deposited on upper to middle shoreface due to continuous wave action during fluctuating sea level.

Above mentioned sandstone is mostly capped by coarse to very coarse grained, ridge forming, moderately to poorly sorted sandstone rich in fossil fragments of gastropods and oysters with less commonly developed trough - low angle cross-bedding. This sandstone was derived from topographically higher parts of the beach during storms and deposited below the fair weather wave-base by ebb currents. Greenish grey shale is interspersed at various levels between sandstone horizons. A depositional environment of foreshore beach has been interpreted for the Nal section of the Hinglaj Formation (Sheikh et al., 2005).

The Bela section (Fig. 3) which is 3780 m thick shows a subaqueous delta plain environment with distal to proximal facies trend from pro-delta plume to delta-front sands. The delta-front deposit is represented by fine to medium grained, moderately to well sorted, mainly trough cross-bedded quartzose sandstone with sporadic fine grained sandstone interbeds that are full of shale clasts. The delta-front zone is sandwiched between thick zones of black to greyish black pro-delta plume shales with intercalated sandstone having hummocky and trough cross-bedding. The aforesaid subaqueous delta-plain deposits are overlain by fine to medium grained, friable to moderately compacted eoline sand repeatedly cut by tidal channels (Sheikh et al., in Prep).

METHODOLOGY

Thirty two samples were collected from the two studied sections of the Hinglaj Formation. Samples from the thick and well sorted horizons which megascopically display the pure quartzose mineralogy were avoided. Most of the samples were collected from the ridge forming beds of medium to coarse grained hard sandstone. Their coarse nature indicates the insufficient reworking but nourishment from the same source. It is suggested that they can provide a closer clue about the parent rocks. Further constraints are based on grain size and colour variation of the selected 70 samples from 1430 m thick Nal section. About 50 m upper part of the formation is eroded. Sample No. 46-50 and 52 were collected from a 25 m thick, intensely weathered, isolated outcrop exposed after the eroded part. Thus, 22 samples were selected for thin section study from Nal area (Fig 15).

The Bela section lacks in ridge forming, coarse grained horizons of sandstone and does not display a clearly visible grain size difference. Most of the sandstone horizons are fine grained, entirely quartzose and loose to moderately compacted. The sampling from very fine grained sandstone of the shale dominated lower part and loosely compacted, friable sandstone from the upper part has been neglected. Thus majority of the samples were collected between 870-2140 m. So only 10 samples (Fig. 16) from the Bela section were included in petrographic study, suggesting that the sandstones of Bela section have undergone long term physical reworking in an energetic environment and the information about the original modes has been lost (Mack, 1984).

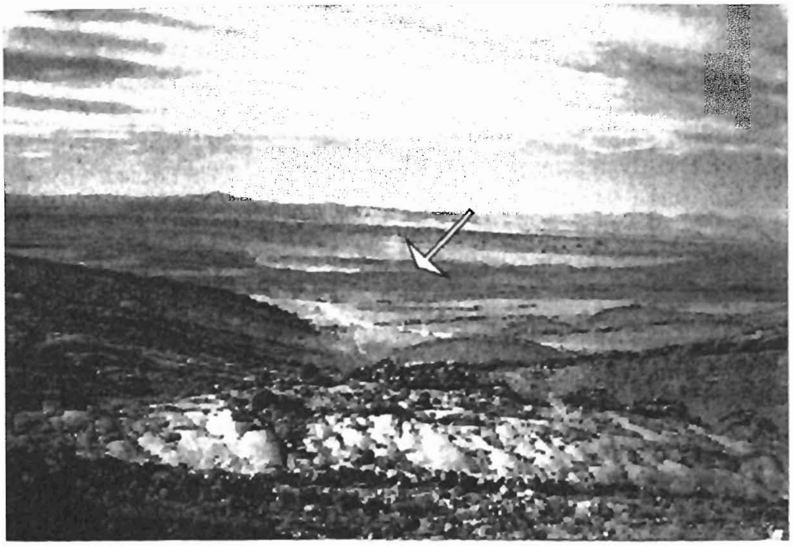


Fig. 2. General view of the Hinglaj Formation in the Nal area showing lensoid morphology of trough cross-bedded, quartzose sandstone (arrowed) capped by brown to dark brown, coarse, thin bedded sandstone. This view (lower part of the figure is ~ 100 m across.

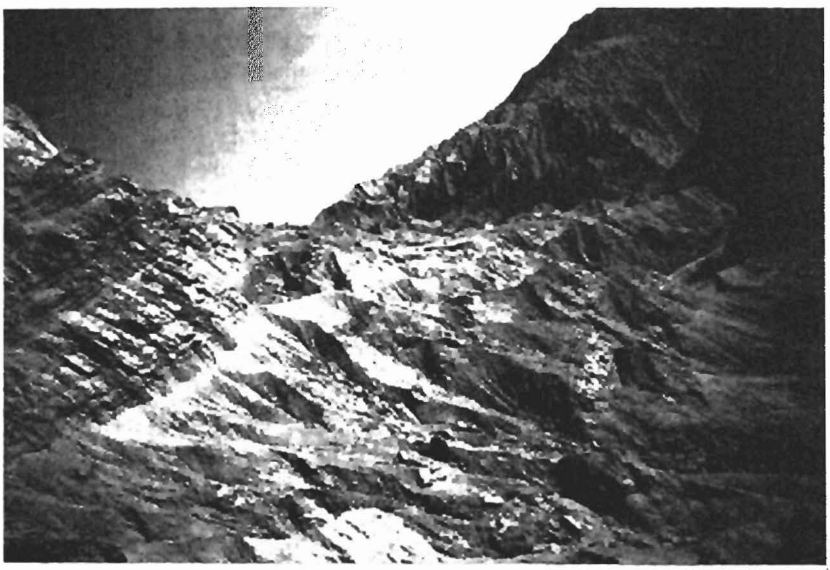


Fig. 3. General view of Hinglaj Formation in Bela area. Lower contact with the Parkini Mudstone (lower right) is also clear. This view is ~500 meter across.

PETROGRAPHY

The percentages of the framework grains have been deduced from point counting using the traditional method (Dickinson, 1988). All the thin-sections were studied under the transmitted light petrographic microscope and an average of 400 points per slide were counted. The point counting represents the volume of the original grains. If a large quartz grain in a siltstone or fine sandstone fragment was encountered it was treated as sedimentary rock fragment. All the framework and non-framework grains were counted. They include monocrystalline quartz, polycrystalline quartz, chert, plagioclase feldspar, potash feldspar, sedimentary, volcanic rock fragments, biotite, muscovite, heavy minerals (including zircon, hornblende, sphene, rutile, epidote), opaque minerals, shell fragments, algae fragments and microfossils. Brief description of the lithic framework grains has been described below in the order of decreasing abundance.

Quartz

This is the most abundant detrital mode. The volume of monocrystalline quartz (Qm) varies from 28.13 % to 88.44 %. Nearly all the monocrystalline quartz show undulatory extinction. The samples from clean & white, mainly trough crossbedded horizons display quartzose mineralogy (Fig 4) which implies long-distance sediment transportation (Velbel, 1985). The quartz population from such horizons is angular to sub-angular having the size range of 0.15-0.22 mm. The average quartz grain size is 0.17-0.29 mm. A significant proportion of the grains are rounded with an angular broken end (Fig 4). This feature reflects the disintegration of well rounded, metamorphic quartz grains broken due to continuous wave action (Sheikh et al., 2005). Very few grains are slightly undulose in which the grain is a single individual and the extinction shadow sweeps smoothly without break across the grain. More than 70% grains are highly undulose and the undulosity generally varies from 15°-40° showing clear breaks in sweeping shadow.

The polycrystalline quartz populations were found in coarse grained samples and range upto15 %. They are frequently rounded to sub-rounded and range in size from 0.2-1.25 mm with an average size of 1mm. They are mostly composed of numerous crystallites with very differing optical continuities. (Fig 5). The dominance of well rounded, coarse grained polycrystalline quartz in the moderately to poorly sorted thin horizons is indicative of insufficient reworking (Sheikh et al., 2005). The crenulated boundaries are rarely observed and the majority of them are polygonized with segmented undulosity, deformation bands and polyhedral outlines. Polycrystalline quartz with sutured boundaries has been observed in the samples from the upper horizons (Fig. 6) which indicates progressive erosion of metamorphic terrain at shallow depth.

Sedimentary Rock Fragments

Fine sandstone to siltstone are the main types of sedimentary lithic clasts (Fig 7). Their amount varies from 0-24.8 %. The carbonate rock fragments and ironstone fragments (Fig 8) were rarely encountered in some samples. In the siltstone fragments the individual quartz grains range in size from 0.025-0.75 mm, bounded by micrite and rarely iron oxide cement. All of the sedimentary rock fragments are rounded with a size range of 0.275-1.75 mm. The average grain size in most of the samples is 1.16-1.25 mm and the majority of them encountered in coarse grained samples. The dominance of sedimentary lithic clasts over the igneous clasts suggests that the extrabasinal control on sedimentation was distinctly controlled by the fine grained clastics.

Volcanic rock Fragments

The amount of volcanic lithic clasts ranges from zero to moderate. They are ranging upto 17.42 %. Their textural and compositional characteristics do not vary considerably. The groundmass is mostly altered which cannot be recognised even on a higher magnification. However, some relatively fresh grains show interlocked feldspar laths of varying size that are interspersed in the cryptocrystalline groundmass (Fig.9). The plagioclase laths are also arranged in a fluidal or vitric fabric having obsidian traces. All of them are rounded to well rounded and range in size from 0.87-2.5 mm having the average size of 1 mm.

Chert

Chert population comprises a notable proportion ranging upto 13.22 %. They are mostly rounded to sub-angular with a size range of 0.62-3 mm. Nearly all of the chert grains contain recrystallized radiolarians with a chalcedonic appearance.

Mica

Both varities i.e. muscovite and biotite have been observed in the form of thin flakes. Muscovite is present in slightly higher amount as it is more resistant to weathering. Muscovite and biotite range upto 3.21 and 2.37 % respectively. Biotite gives a dark brown hue in plane and polarized light. The size of micas does not exceed from 0.1-.275 mm. They are slightly abundant in the fine grained sandstone of Bela section.

Heavy and opaque minerals

The heavy minerals have not been included in the provenance interpretation yet they comprise a significant proportion. They are dominated by zircon, hormblend, sphene, rutile and epidote. Their amount ranges upto 0.96 %, 2.30 %, 2.40 %, 1.06 % and 0.84 % respectively. The opaque minerals are present in a greater amount ranging from 1.29-17.75 %. Mostly the heavy minerals are altered or replaced by calcite making it difficult to identify them even on a higher magnification. Some of the unaltered minerals have been identified by their cleavage and slightly preserved crystal shape. The size of both the heavy and opaque minerals range from 0.025-.3 mm. Size of 0.05 is very common. In most of the samples their average size range from 0.18-0.23 mm.

Feldspar

Feldspars content is extremely low and range upto 8%. In the 22 samples from the Nal sections 8 samples contain no feldspar. Also in the Bela section, most of ten samples are devoid of feldspar. The plagioclase. to total feldspar ratios are high (3:1). Plagioclase occurs upto 8.45 %. It is mostly subangular to sub rounded having a size range of 0.075-0.15 mm. Calcite to sericite alteration is rarely present. Many of the plagioclase grains are twinned and some zoned.

Trace amount of microcline has also been observed in few coarse grained samples ranging upto 3.80 %. They are mostly subangular to subrounded having an average size range of 0. 2 mm.

Data Compilation and Parameters for Ternary Diagrams

The petrographic analyses of mostly medium to coarse grained, moderately to well sorted samples of the Nal section indicate that the respective Mean & Standard Deviation (%) values of the frame work grains are 58.22 &18.78 for monocrystalline quartz, 4.95 & 4.46 for polycrystalline quartz, 2.08 & 2.69 for plagioclase feldspar, 0.67 & 1.02 for potash feldspar, 1.53 &3.54 for chert, 4.82 & 6.41 for sedimentary rock fragments, 4.02 & 5.53 for volcanic rock fragments, 0.46 & 0.80 for biotite, 0.43 & 0.82 for muscovite, 2.07 & 2.54 for shell fragments, 6.85 & 5.66 for microfossils, 6.60 & 8.58 for augite, 0.19 & 0.33 for zircon, 0.44 & 0.64 for hornblend, 0.17 & 0.49 for sphene, 0.12 & 0.31 for rutile, 0.06 & 0.20 for epidot and 5.57 & 4.81 for opaque minerals respectively.

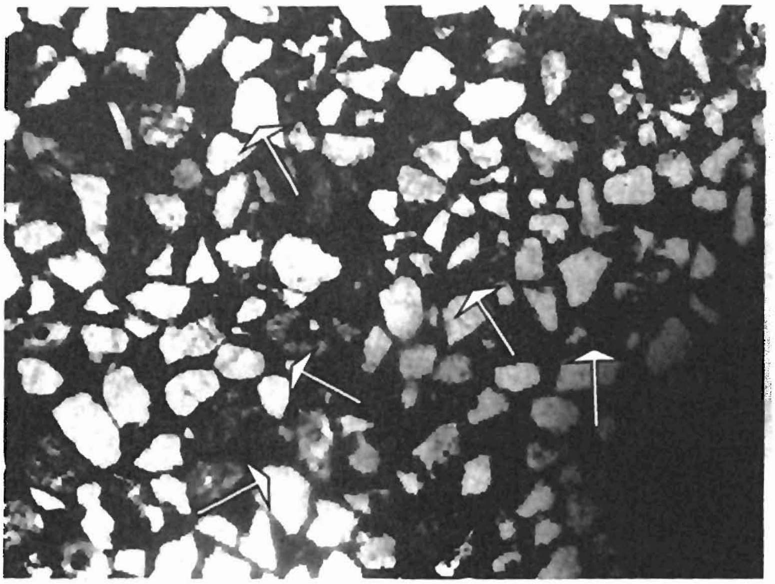


Fig. 4. A Photomicrograph from fine to medium grained quartzose sandstone, bounded by iron oxide cement. Arrows indicate the rounded grains with a broken end due to grain attrition by continuous reworking of waves. (Sample No. HJ-8 PPL, 40 X.

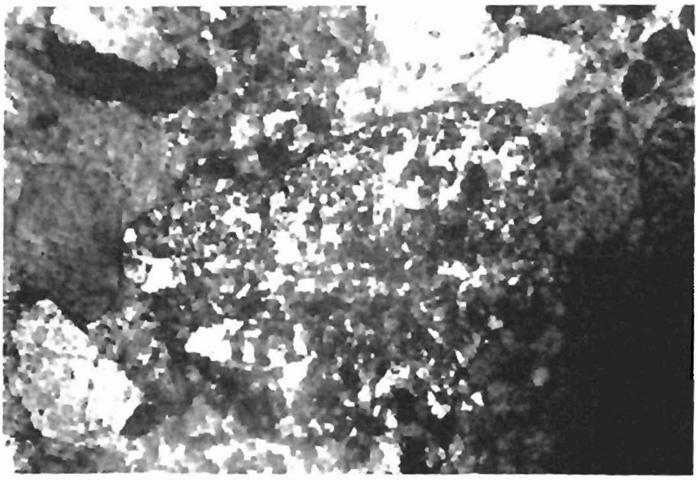
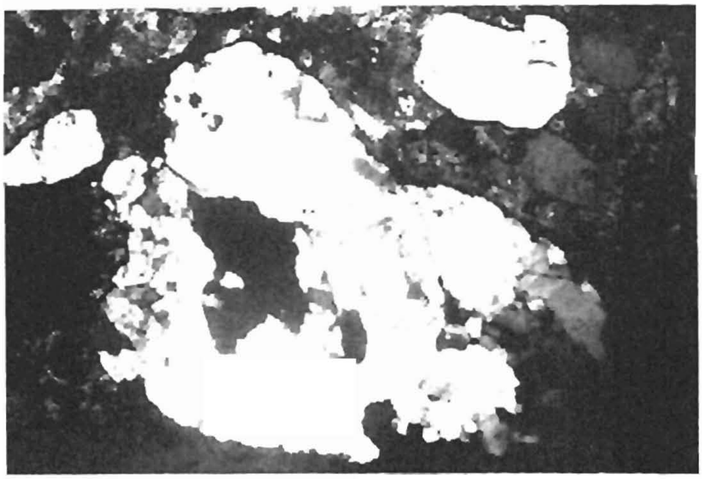
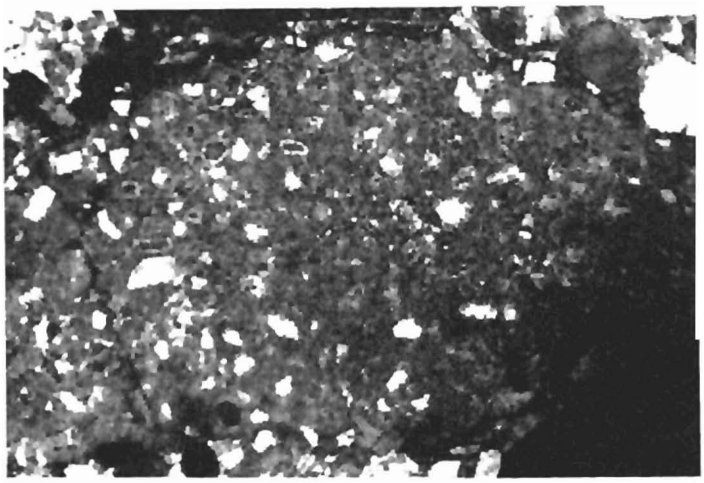


Fig. 5. Photomicrograph of a polycrystalline quartz (center) with numerous crystallites (Sample No. HJ-31, XPL, 40X).





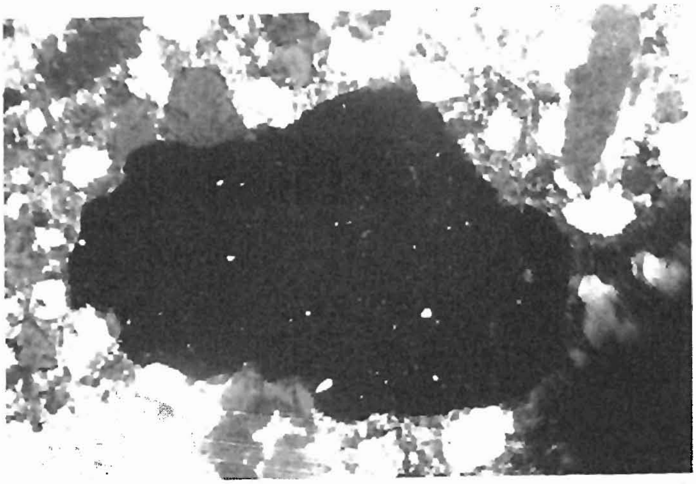


Fig. 8. Photomicrograph of an ironstone fragment with small quartz crystals.

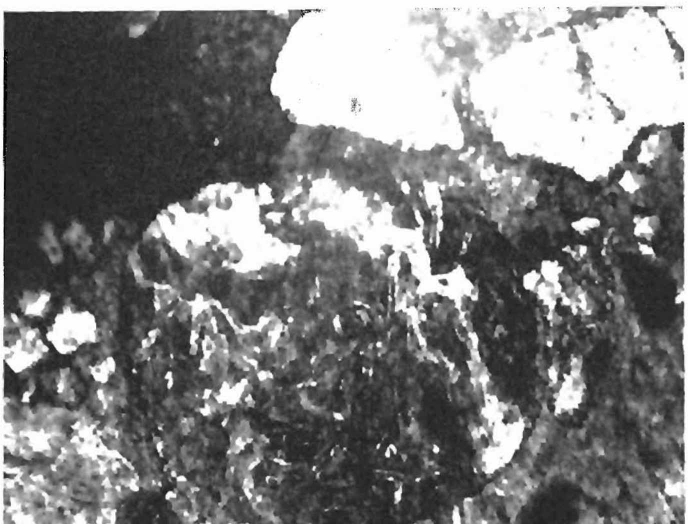


Fig. 9. Photomicrograph of a well rounded volcanic rock fragment with interlocked plagioclase lathwork fabric. Few quartz crystals are visible near the margin of the grain (Sample No, HJ-47, PPL, 40X).

While the respective Mean & Standard Deviation values of frame-work grains of the Bela section are 71.74 & 11.30 for monocrystalline quartz, 2.10 & 3.73 for polycrystalline quartz, 0.90 & 1.25 for plagioclase feldspar, 0.05 & 0.14 for potash feldspar, 1.28 & 1.17 for sedimentary rock fragments, 2.21 & 2.95 for volcanic rock fragments, 2.88 & 3.23 for biotite, 0.63 & 0.86 for muscovite, 1.01 & 1.65 for shell fragments, 5.90 & 8.43 for microfossils, 1.99 & 2.07 for augite, 0.72 & 0.53 for zircon, 0.59 & 0.75 for hornblend, 0.04 & 0.11 for rutile, .0.04 & 0.13 for epidot and 7.92 & 3.59 for opaque minerals respectively.

The recalculation of the framework grains was performed and the point counting data was plotted following the scheme of Dickinson (1988). The following parameters were identified and used in the ternary diagrams.

Q = Total quartzose grains (Qm+Qp)
Qm = Monocrystalline quartz
Qp = Polycrystalline quartz including chert
F = Total monocrystalline feldspar (P+K)
P = Plagioclase feldspar
K = K-felspar (orthoclase and microcline)
Lt = Total lithic fragments (L+Qp)
L = Unstable lithic fragments (Lv+Ls)
Lv = Volcanic lithic fragments
Ls = Sedimentary lithic fragments excluding chert

RESULTS

Table 2 & 3 show the original point-counts and their recalculated parameters for QFL, QmPK, QmFLt and QpLvLs. The detailed analyses and comparison of the ternary plots with the provenance fields (Dickinson, 1988), suggest a recycled orogen provenance for the Hinglaj Formation. The plots of QFL (Fig. 10) and QmFLt (Fig. 12) of the point-count data coincide best with the fields of the Recycled orogen provenances with a partial overlapping in the field of Continental Block Provenances, indicating increasing maturity and stability. Most of the data points are plotted near the Qm pole. The QmPK plot (Fig. 11) also shows a closer match with the plot of QFL and QmFLt, as the data points are plotted mostly at the Qm pole which displays the increasing maturity and stability from continental block provenances. In the QpLvLs plot (Fig. 13) the data points are scattered across the whole waist of the triangle. This dispersed nature may be the result of moderate to poor sorting of the samples.

The position of the data points in the Dickinson plot, suggest a Recycled Orogen Provenance which is in concurrence with Crame (1984). He suggested that during Neogene times an important submarine delta developed which drained the rising area in the north and transported the sediments southward along the Ornach-Nal Fault. Thick sandstone sequences of Miocene to Pliocene Hinglaj Formation and Middle Oligocene to Pliocene Greeshak Group (H.S.C, 1960) were deposited.

The geological evidence of Crame's (1984) conclusion is not clearly defined as in the north, three magmatic belt occurs which make his statement controversial. The Himalayan crystalline belt is comprised of the northern margin of the Indo-Pakistan crustal plate and is characterized by intensely deformed, tightly folded and imbricated Precambrian to early Mesozoic metamorphic, sedimentary and igneous rocks. This belt is divisible into several segments on the basis of stratigraphy, structural styles, metamorphism and magmatism. Slates, phyllites, quartzites, marbles, quartz schist, graphite schist, quartzofeldspathic gneisses, metamorphosed greywackes and other metamorphosed rocks are reported from the segments of the Himalayan Crystalline Belt (Jan, 1991). The other northern magmatic belt is the Kohistan Island Arc. This magmatic arc has also been divided into northern, central and southern zones on the basis of metamorphism, structures and stratigraphy. Gabbro, diorite and granodioritic intrusions have been reported from its various parts. Its southern part has been termed as highly tectonised shear zone with rocks of granulites, amphibolites metagabbro and orthogneisses (Khan et al., 1993).

TABLE 2. ORIGINAL POINT COUNTS AND THEIR RECALCULATED % AGES FOR QFL and QMPK

Sample No	QFL	Q	F	L	QmPK	Qm	P	K
Nal Section								
HJ-0	74	91.89	8.11	0.00	69	91.30	5.80	2.90
HJ-5	114	100.00	0.00	0.00	114	100.00	0.00	0.00
HJ-6	156	96.79	3.21	0.00	154	96.75	1.30	1.95
HJ-8	67	97.01	2.99	0.00	67	97.01	2.99	0.00
HJ-9	156	97.44	0.00	2.56	150	100.00	0.00	0.00
HJ-12	213	76.06	7.51	16.43	154	89.61	3.90	6.49
HJ-15	182	98.35	0.00	1.65	179	100.00	0.00	0.00
HJ-17	148	85.14	0.00	14.86	122	100.00	0.00	0.00
HJ-19	215	87.44	2.79	9.77	191	96.86	3.14	0.00
HJ-20	168	90.48	4.76	4.76	150	94.67	4.00	1.33
HJ-25	214	63.55	1.40	35.05	123	97.56	0.81	1.63
HJ-27	210	68.10	0.95	30.95	134	98.51	1.49	0.00
HJ-28	152	78.29	10.53	11.18	121	86.78	13.22	0.00
HJ-31	215	45.58	0.00	54.42	75	100.00	0.00	0.00
HJ-34	196	73.47	12.24	14.29	149	83.89	12.08	4.03
HJ-43	266	86.47	4.51	9.02	218	94.50	3.67	1.83
HJ-46	157	84.71	5.10	10.19	114	92.98	5.26	1.75
HJ-47	191	61.26	0.00	38.74	92	100.00	0.00	0.00
HJ-48	228	55.26	0.88	43.86	107	98.13	1.87	0.00
HJ-49	168	76.19	0.00	23.81	125	100.00	0.00	0.00
HJ-50	135	89.63	10.37	0.00	111	87.39	10.81	1.80
HJ-52	234	98.29	0.85	0.85	232	99.14	0.86	0.00
Mean	*175.41*	*81.88*	*3.46*	*14.65*	*134.14*	*95.69*	*3.24*	*1.08*
St. Dev.	*48.75*	*15.07*	*3.85*	*15.88*	*42.64*	*4.85*	*3.94*	*1.64*
Bela Section								
HJ-B-1	171	96.49	0.00	3.51	165	100.00	0.00	0.00
HJ-B-2	241	97.93	0.83	1.24	238	99.16	0.84	0.00
HJ-B-3	151	80.13	1.32	18.54	119	98.32	1.68	0.00
HJ-B-8	177	92.66	0.00	7.34	164	100.00	0.00	0.00
HJ-B-11	171	97.66	0.00	2.34	167	100.00	0.00	0.00
HJ-B-12	132	93.18	4.55	2.27	108	94.44	5.56	0.00
HJ-B-13	209	94.74	0.96	4.31	200	99.00	1.00	0.00
HJ-B-14	229	100.00	0.00	0.00	229	100.00	0.00	0.00
HJ-B-15	180	90.00	5.00	5.00	151	94.04	5.30	0.66
HJ-B-17	94	100.00	0.00	0.00	94	100.00	0.00	0.00
Mean	*175.50*	*94.28*	*1.27*	*4.46*	*163.50*	*98.50*	*1.44*	*0.07*
St. Dev.	*41.80*	*5.64*	*1.82*	*5.17*	*46.08*	*2.20*	*2.07*	*0.20*

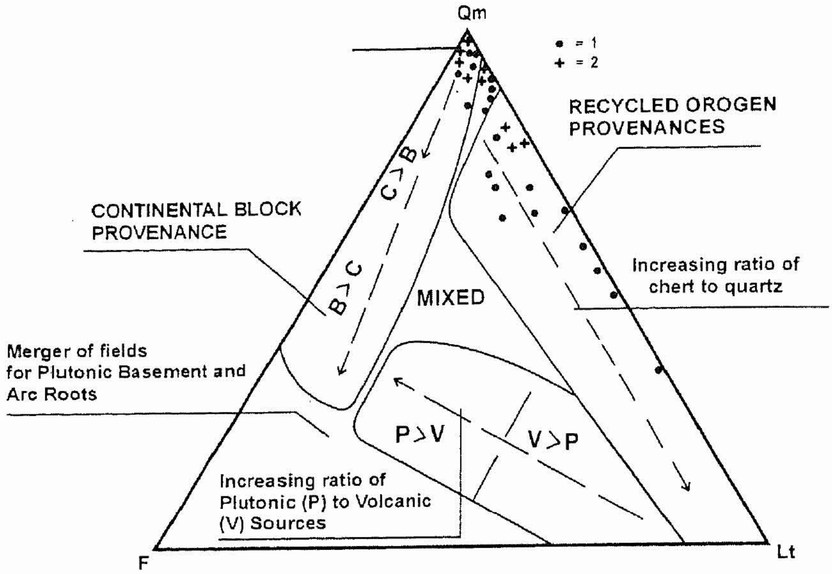


Fig. 12. QmFLt plot of the Hinglaj sediments (N=32), showing their derivation from Recycle Orogen and Continental Block Provenance (Dickinson, 1988).

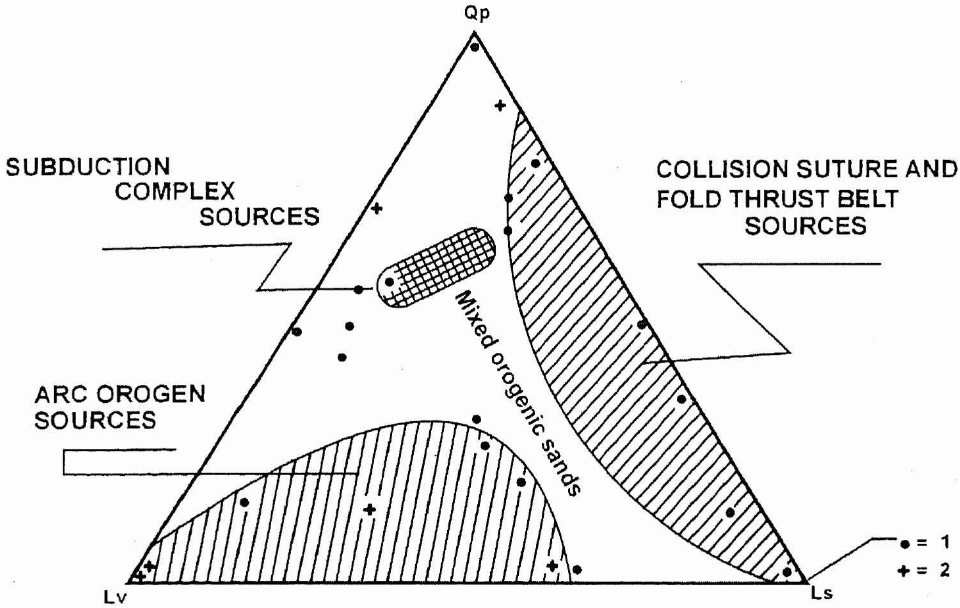


Fig. 13. QpLvLs plot of the Hinglaj sediments showing no concrete evidence of their provenances. The data points (N=32) are scattered which may have been due to the moderate to poor sorting of the samples (Dickinson, 1988).

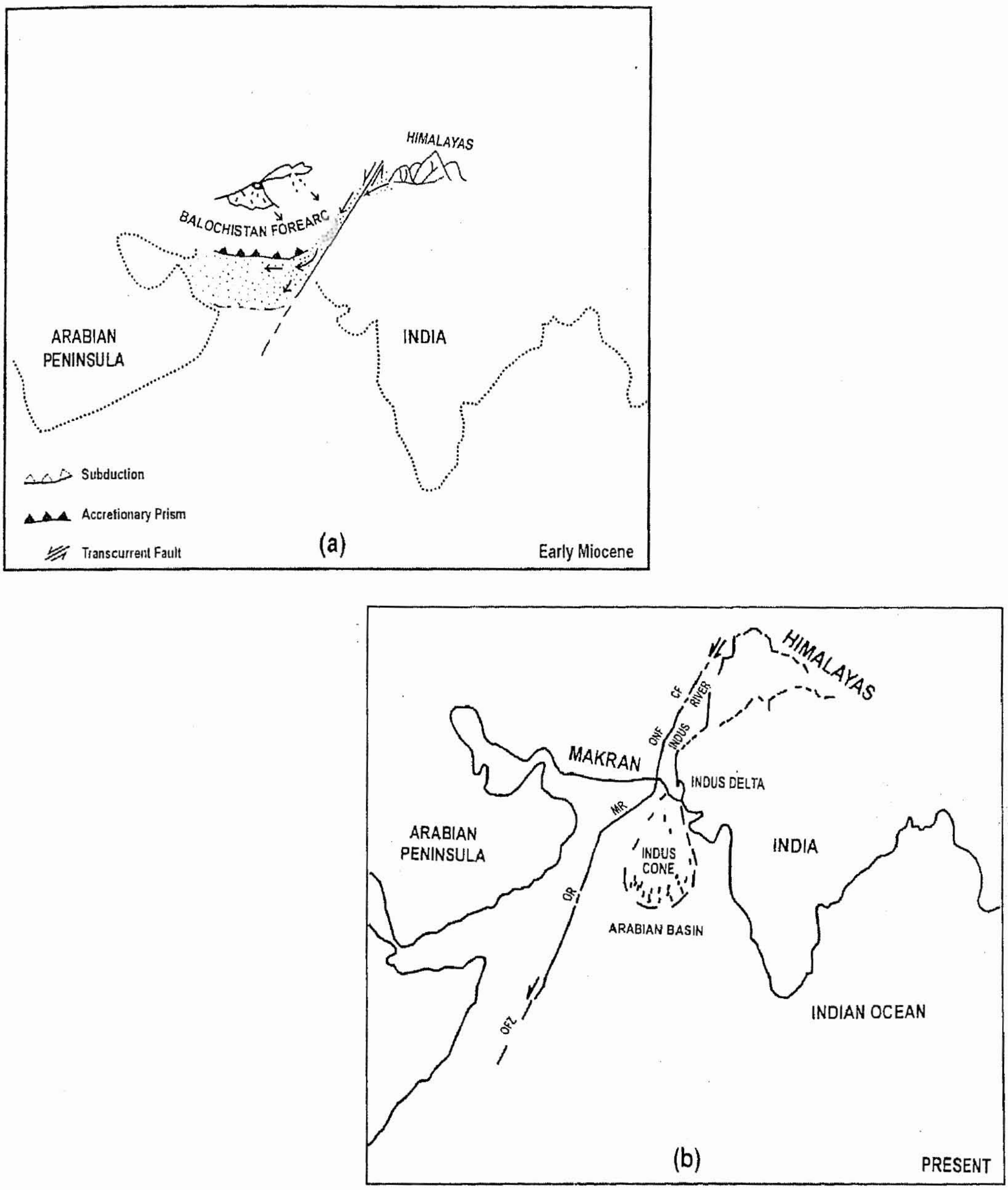
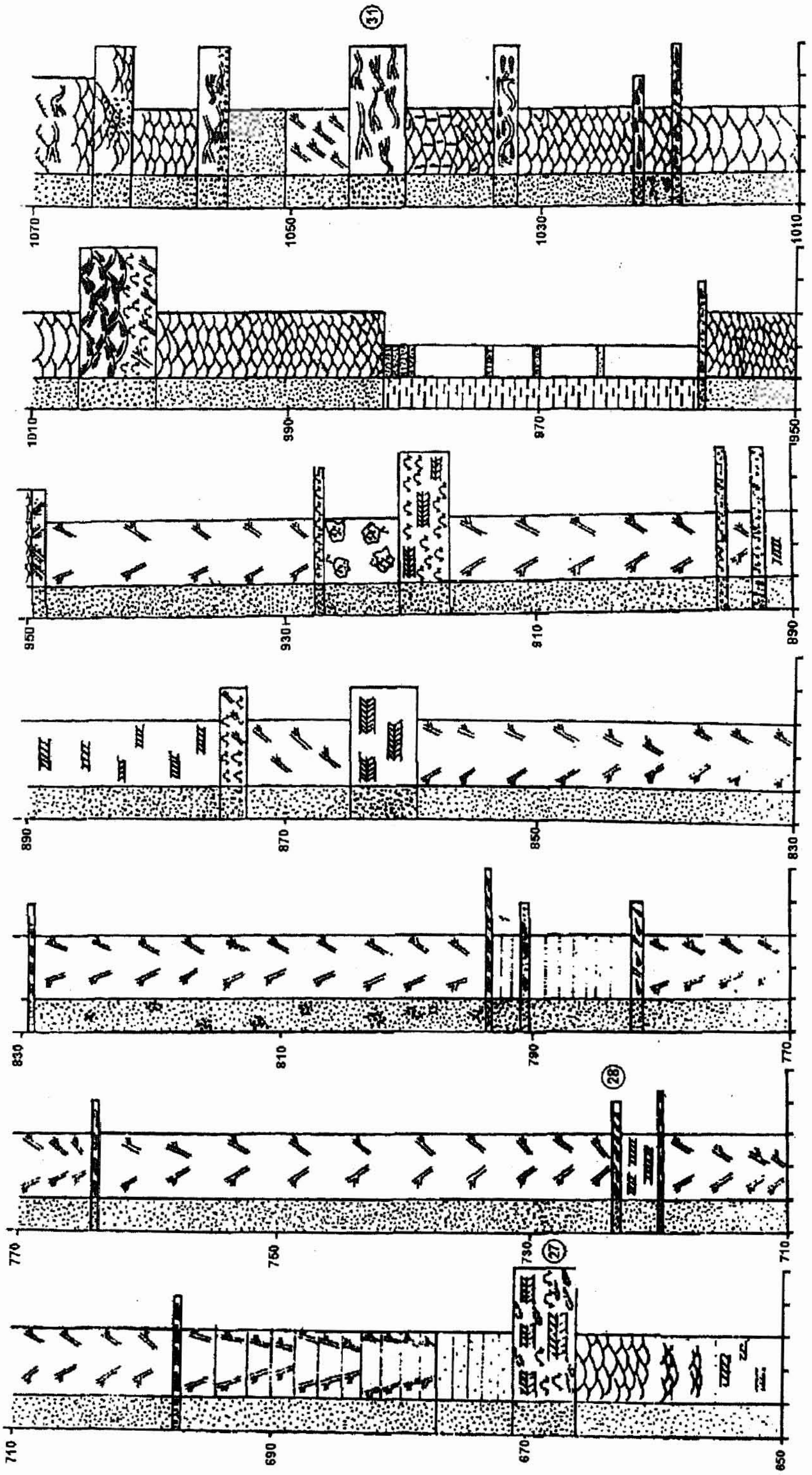


Fig. 14. Important geologic and geomorphic features of the Indian Ocean and Asian Continental margin. (a): Hypothetic relation between the Himalayan Chain and the Hinglaj / Talar sediments at the early Miocene time. Arrows indicate the direction of sediment transport. The dotted lines represent the continental borders at the present day and the position of Arabian Penisula is not relative at this time. (b): Situation at the present day (after Suczec and Ingersoll, 1985). OFZ= Owen Fracture Zone; OR=Owen Ridge; MR= Murray Ridge; ONF= Ornach Nal Fault; CF= Chaman Fault (Not to Scale).



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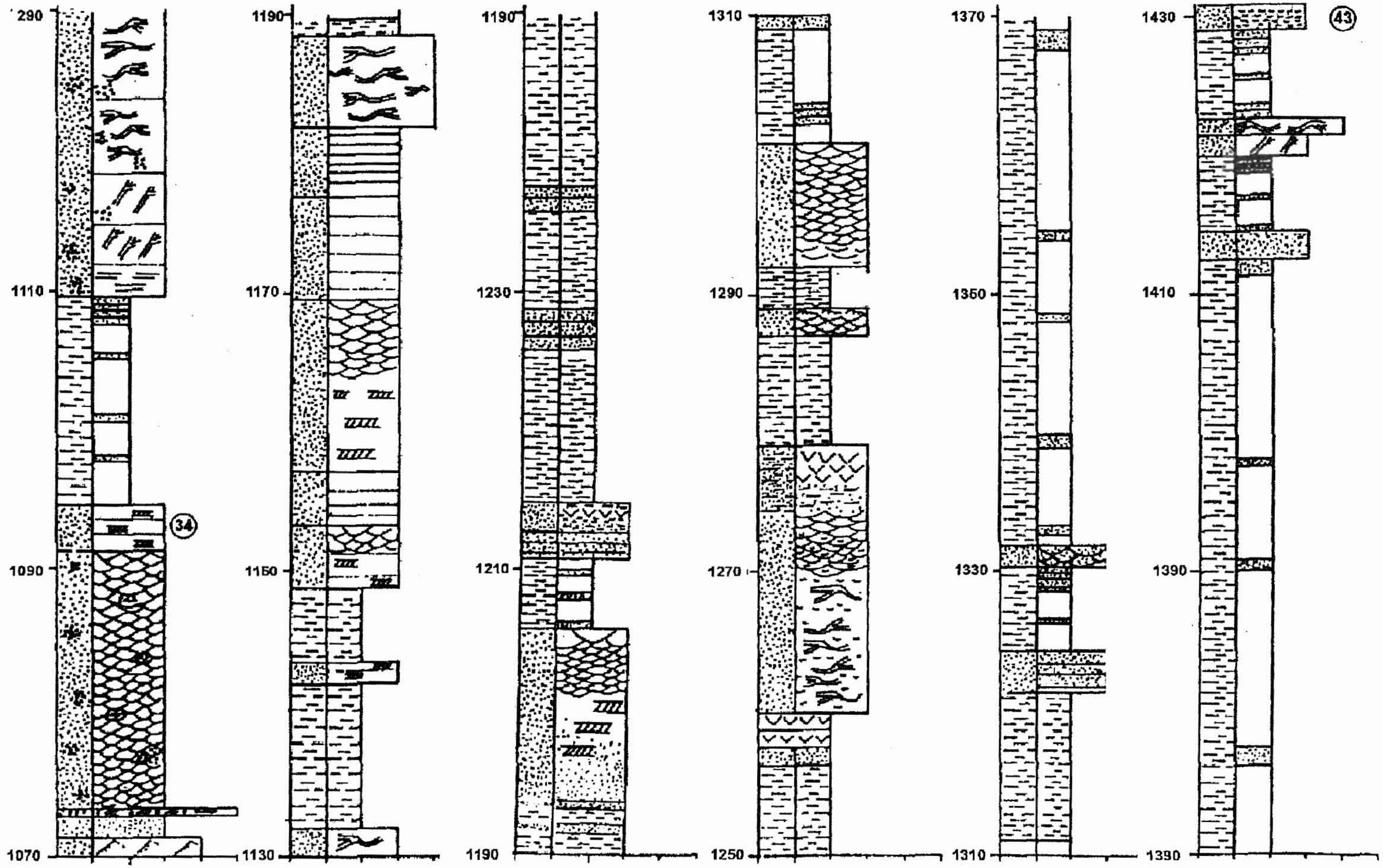
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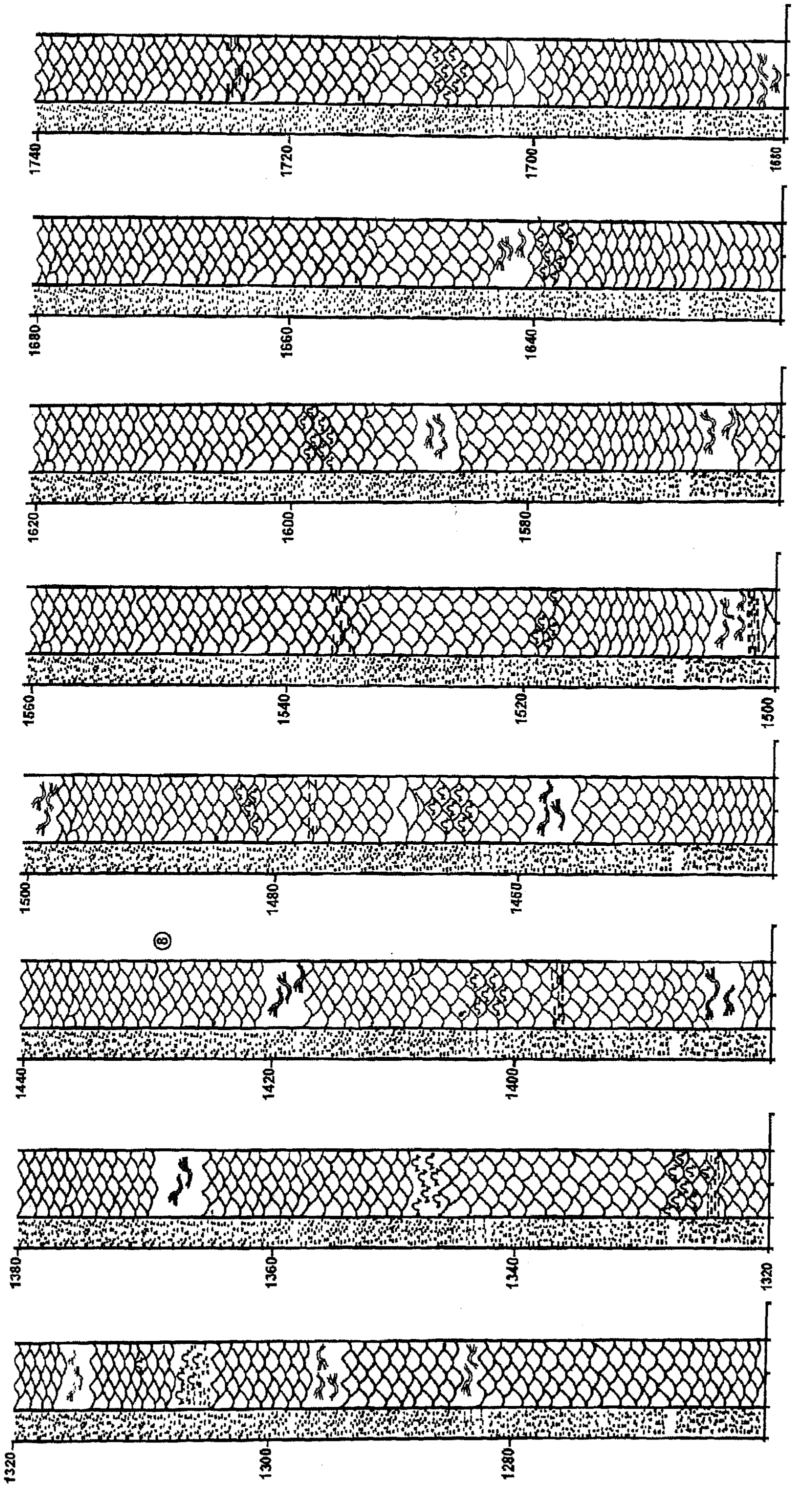
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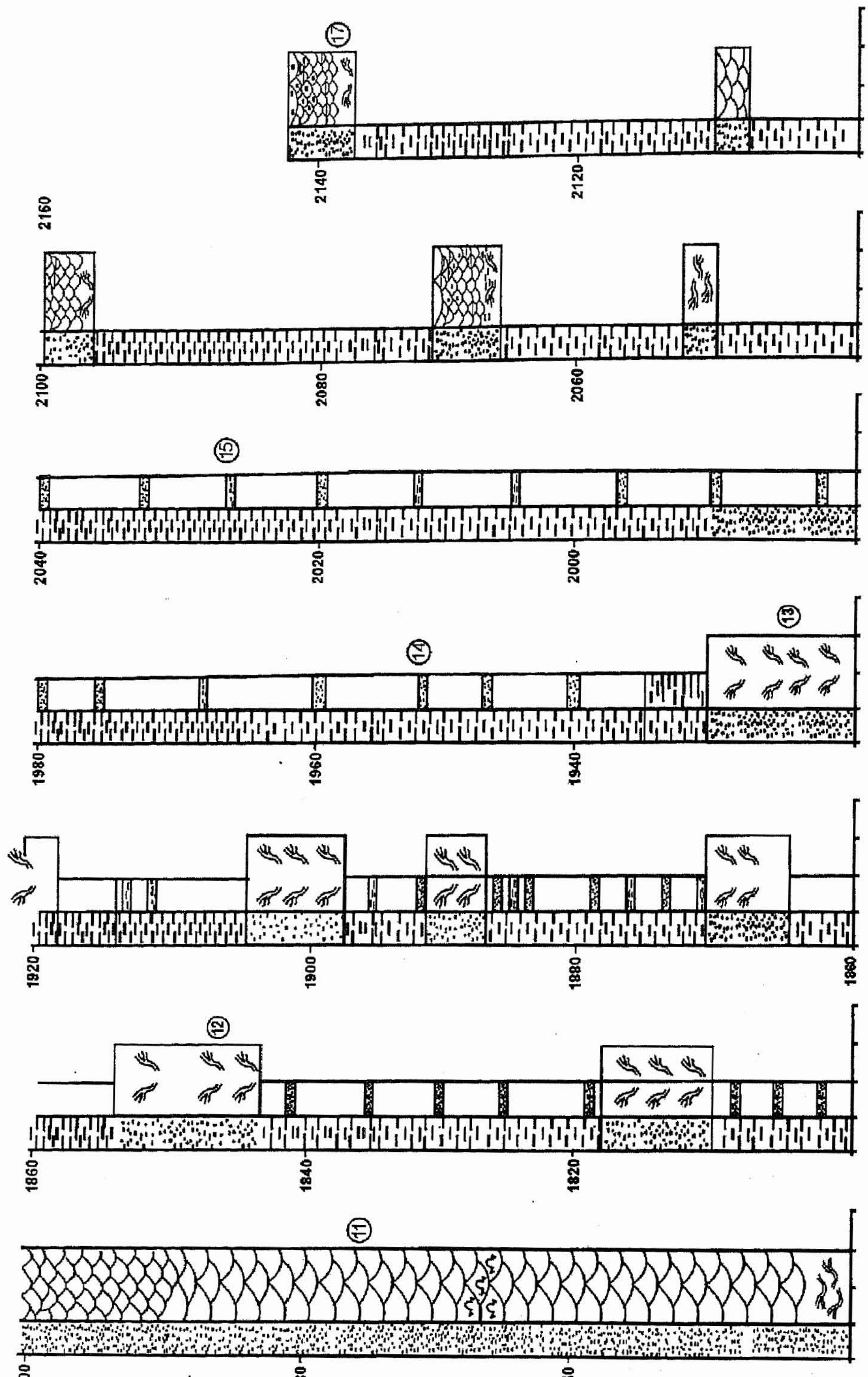

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