PRJ, Vol. 7 (January 1995); P. 95–99, 7 FIGS, 1 TABLE.

FOSSIL PHYTOCLASTS IN OILS FROM MESSLAH AND BOURI OIL FIELDS – LIBYA: A PRELIMINARY STUDY

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متحجرات الفتات النباتية في نفط حقول الميسلي والبوري — ليبيا : دراسة أولية

ر. ن. سنها وهـ. ب. ايلاند

يحتوي النفط المنتج من آبار حقول الميسلي والبوري على رواسب يحتمل أن يكون مصدرها الصخور المولدة ، الخزانات النفطية وبقية الصخور التي إنتقل النفط خلالها عبر الأزمنة الجيولوجية.

إن دراسة الفتات النباتية المحتواة في النفط الخام يمكن أن تساعد على ربطها بالصخور المولدة. تم دراسة الجزء الفتاتي ومحتوياته في المتحجرات البالينولوجية في حقول الميسلي والبوري. وقد تم استخدام تقنيات مخبرية متطورة لفصل واستخراج المتحجرات البالينولوجية من النفط الخام.

المحتويات الفتاتية في عينات النفط التي تم دراستها قليلة جداً والفتات النباتية كذلك قليلة جداً. وقد شوهدت متحجرات بالينولوجية نذكر منها نوع البسيلانراليس ونوع السايكودونيس وحبوب اللقاح الرباعية ويحتمل كذلك وجود نوع ريترايكولبايتس. أما بقية الفتات النباتية فتحوي بقايا نباتية وبالينولوجية ومادة عضوية ذات لون أسود إلى بني عميق. كما أن المتحجرات البالينومورفية المكتشفة ذات عمر جيولوجي طويل ، إلاّ أنه يصعب تحديد عمرها بدقة.

وتجدر الإشارة بأن عينات النفط التي إستخدمت في هذه الدراسة قد جمعت بعد الفصل (Separators) وهذا يفسر قلة الفتات النباتية والبالينولوجية في هذه العينات. وللحصول على نتائج أشمل وأدق يستوجب دراسة كل من العينات المجمعة قبل الفصل وكذلك الرواسب المتبقية في الفاصل (Separator).

ABSTRACT

Oils produced from wells contain sediments possibly drived from source, reservoir and such other rocks through which the oil migrated during the geologic past. Study of phytoclasts in the particulate content of oils may thus be helpful in relating it to the most probable source rocks. Clasitic fraction and its palynofossil contents in oils of Messlah and Bouri fields were studied. To extract and separate the palynofossils from the crude oils a special laboratory technique has been evolved.

The sediment content in oil is very low and that of the fossil phytoclasts, extremely poor. Only a very few palynofossils were recovered. These include ***Psilatriletes*** *sp.,* ***Cycadopites*** *sp. tetralete pollen grain and possible* ***Retitricolpites*** *sp. The rest of the fossil phytoclasts comprise plant remains, possible palynomorphs and black to dark brown organic matter. The recovered palynofossils are long ranging in age and it is not possible to relate them to any specific age.*

The studied oil samples were collected after the separators and this could explain the overall extremely low yield of phytoclasts and palynofossils. It seems necessary to study oil samples collected before the separators and also, the sediments retained by the separators for more meaningful and conclusive results.

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INTRODUCTION

The onshore Sirte Basin of Libya hosts many oil fields. Some of these produce gas. Fourteen oil fields are classified as giants (Table 1) and each of these have reserves exceeding 500 mill. bbls. (Halbouty *et al.*, 1970 and AGOCO, 1980).

Offshore oil production is from the Bouri Oil Field. Oil is produced from various stratigraphic units ranging in age from Cambro-Ordovician to Oligocene. It is also produced from fractured Precambrian igneous-metamorphic basement.

Geochemical studies by Robertson Research International (1979) and subsequent evaluation of avail-

Table 1. Source and Reservoir Rocks of Oil in Giant Oil Fields, Libya

Oil field	Reservoir rock[1]		Source rock[3]		Rec.
	Lithology	Age	Lithology	Age	Reserves (Mill. Blls)
AMAL	Sandstone	Early Cret. & older	Unnamed Shale	Triassic	
AUGILA-NAFOORA	Carbonate (metam basem)	Eocene Precambrium	Sirte Shale	Campanian Cret	5200[1]
BUATTIFEL	Sandstone	Early Cret.	Variegated shale	Early cret.	1000[1]
DAHRA+HOFRA	Carbonate	Paleocene	Shale	Campanian	700[1]
DEFA	Carbonate	Paleocene	Shale	Campanian	2000[1]
GIALO	Sandstone Carbonate	Oligocene Eocene	**Shale**	Carmpanian	2000[1]
INTESAR 'A'	Carbonate	Paleocene	Shale	Campanian	1500[1]
INTESAR 'D'	Carbonate	Paleocene	Shale	Campanian	1200[1]
MESSLA	Sandstone	Early Cret	Shale	Campanian	1500[2]
RAGHUBA	Carbonate	Late Cret.	Shale	Campanian	1000[1]
	Sandstone	Cambro-Ord.	Shale	Campanian	
SAMAH	Carbonate	Late Cret.	Shale	Campanian	1305[1]
	Sandstone	Cambro-Ord.	Shale	Campanian	
SARIR	Sandstone	Early Cret	Shale	Campanian	8000[1]
			Variegated Shale	Early Cret.	
WAHA	Carbonate	Paleocene	Shale	Campanian	1000[1]
ZELTEN	Carbonate	Paleocene	Shale	Campanian	2280
BOURI	Carbonate	Early Eocene[3]	Shale & Marl	Maastrichtian[4]	?

1. After Halbouty et al., 1970. 2. After AGOCO, 1980.
3. After Robertson Research Int., 1979 & Al-Alami et al., 1989.
4. After I.Y. Meraheel, Petroleum Research Centre,- personal discussion, 1992.

able geochemical data (Hamayouni *et al.*, 1984) indicate that the oil of the Sarir Field (Table 1) was possibly generated by the Early Cretaceous Middle Nubian variegated shales as well as the Campanian Sirte Shale; the oil in the Nubian Sandstone of Buattifel Field was generated by the Early Cretaceous Middle Nubian variegated shales. The Triassic shales (unnamed) might have sourced the oil of the Amal Field. The oils of the giant Augila-Nafoora, Dahra-Hofra, Defa, Gialo, Intesar-A, Intesar-D, Raghuba, Samah, Waha and Zelten fields and the rest of the smaller onshore fields are thought to have been generated by the Campanian Sirte Shale (Al-Alami *et al*, 1989). Oil in the Early Eocene limestone and dolomites of Jedier and Jerami formations of the Bouri Field in the offshore could have been generated by the mostly Maastrichtian shales and marls of Al Jurf Formation (Hammuda *et al.* 1985).

Oils, in general, contain 0.1% or less (by weight) of sediment fraction. These are eliminated as far as possible by separators. Some of these, however, escape the separators and get into the flow line.

The detrital fraction of the oil, which contains fossil phytoclasts, is contributed by sedimentary sequences comprising the source, reservoir and other rocks through which the oil migrated or came in contact during the geologic past. Thus a study of fossil phytoclasts in oil is likely to offer valuable clues on the age and environment of source and reservoir sequences as well as rocks of immigration path. It was with this notion that the present study was undertaken. The results, herein reported, are based on the study of 54 permanent mounts of clastic fraction isolated from six oil samples from the Messlah and Bouri oil fields. It should be emphasised that these samples were collected after the separator. Their clastic content is, hence, very scarce. Consequently, the recovered fossil phytoclasts cannot be expected to yield a conclusively representative assemblage of clastics and fossil phytoclasts.

SEPARATION OF CLASTICS

Nearly 200 cc. of the oil sample, mixed with 100 cc. of carbon tetrachloride (CC14), was heated to about 50°C and centrifuged at 2000 RPM for 15 minutes before filtering through Whatman filter paper no. 54. The retained clastic fraction was extracted for 6–8 hours with a 10:1 mixture of Benzene:Toluene. Final extraction was carried with Hexane for one hour. The extracted clastic fraction was treated with Hydrofluoric Acid (HF), washed and mounted on glass slides. The quantity of the recovered clastic fraction was generally very scarce and it was thought prudent to avoid separation using $ZnBr_2$. In some cases if the material was extremely fine and low in quantity, it was neither treated with HF nor subjected to separation. Permanent mounts were prepared using "Eukitt" a commercial mounting media.

ASSEMBLAGE OF CLASTIC MINERALS IN OIL

1. Messlah Oil

The yield, though poor, is relatively more than that recorded from Bouri Oil. Ore minerals are fairly scarce and include hematite, limonite, possibly magnetite and rarely a few grains of mutually interfering crystal aggregates of pyrite. The non-opaque suite comprises quartz and chlorite and very scarce to rare feldspars, chloritoid and micas. Quartz and micas generally display strain shadows.

2. Bouri Oil

Clastic minerals are very rare. These include few ore minerals and possible some grains of quartz.

ASSEMBLAGE OF PHYTOCLASTS IN OIL

The yield of fossil phytoclasts is fairly low to very low. Black to very dark reddish brown coloured, at times almost opaque, dull, angular to subangular and even irregularly shaped, amorphous to nonstructured, compact organic material is fairly common. Pale-brown, yellowish brown, reddish brown, dark amber and dark to very dark raddish brown and at times almost opaque grains suspected to be resin/resinous matter are observed. Dark brown to black coloured filamentous organic matter is also observed. Pale brown structured organic matter displaying cellular features are noticed. Their specific identification was, however, not possible.

Recovery of identifiable fossil palynomorphs from the oil samples is extremely poor. They were generally not recorded in most of the slides. The following enlists those which could be recognized.

Figure 1. *Psilatriletes* sp, Messlah Field, X1250. Amb is triangular with very slight convex sides, not very clear trilete mark.

Figure 2. Possible palynomorph, Messlah Field, X1250.

Figure 3. *Psilatriletes* sp., Messlah Field, X500. Amb is triangular with convex sides. Commissure is simple. Exine is possible scabrate.

Figure 4. Tetralete pollen grain, Bouri Field, X1250, Scale bar = 6 μm. The diameter is 27 μm. The single cell measures 19.2 μm. Exine is possibly scabrate.

Figure 5. Palynomorph or recent contamination, Bouri Field, X1250.

Figures 6. and 7. Pieces of palynomorphs, Bouri Field, X1250. The sizes are: 9 × 18 μm and 15 × 24 μm respectively, the wall is dark brown.



FIG. 1. *Psilatriletes* sp, Messlah Field, X1250.



FIG. 2. Possible palynomorph Messlah Field, X1250.

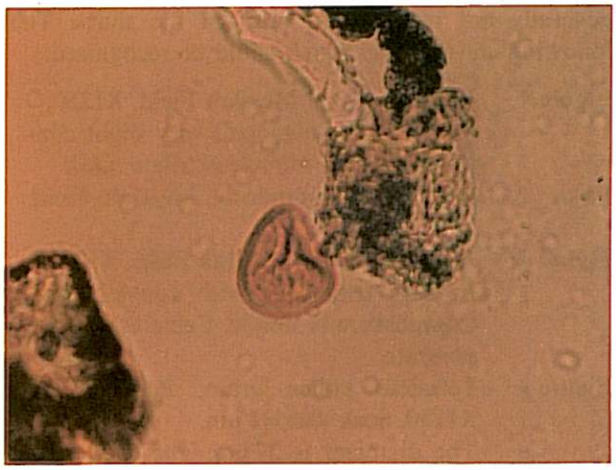


FIG. 3. *Psilatriletes* sp. Messlah Field, X500.

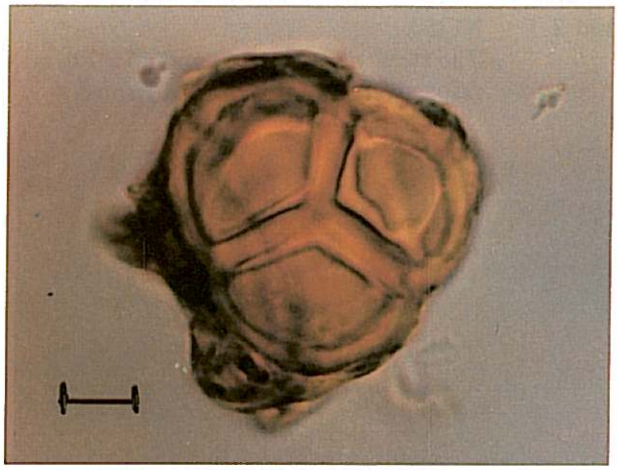


FIG. 4. Tetralete pollen grain, Bouri Field, X1250, Scale bar = 6 μm.

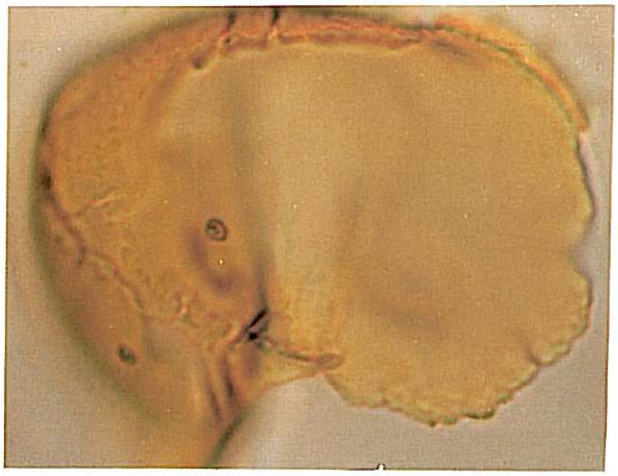


FIG. 5. Palynomorph (or recent contamination), Bouri Field, X1250.

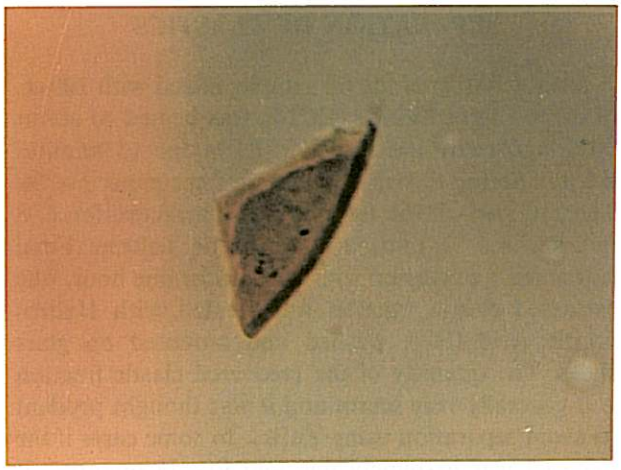


FIG. 6. Piece of palynomorph, Bouri Field, X1250.



FIG. 7. Piece of palynomorph, Bouri Field, X1250.

DISCUSSION

The study establishes presence of fossil phytoclasts and palynofossils in the clastic residues isolated from crude oils of Messlah and Bouri oil fields. The recovered palynofossils could be contributed either by the source or reservoir rocks or by others through which oil has migrated during the geologic past. The recorded phytoclasts are long ranging and non-diagnostic of any specific age. Their colour range to dark brown which pertains to a mature facies. They seem indigenous to the source or reservoirs or others through which the oil migrated or came in contact.

The studied samples were collected after the separators which trap almost all the sediments. This reasons out the low rare yield of the clastics and consequently, the fossil phytoclasts and palynofossils. For a more objective and possible conclusive results, it is necessary to study oil samples obtained before the

separators and also the clastics trapped by the separators since these are likely to yield a better palynofossil assemblage, both qualitatively and quantitatively. It may be more rewarding to study a large number of such samples preferably collected from closely spaced wells producing liquid hydrocarbons from the same reservoir.

CONCLUSIONS

- A laboratory technique to extract palynofossils from the sediment fraction in crude oils has been evolved after extensive experimentation.
- The present study establishes that the clastic fraction in oil contains palynofossils. These could be utilized to inform the age and environment of the more probable source – reservoir rocks of hydrocarbons.

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