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History of the French discoveries in the Sahara

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The Sahara desert covers about 9 000 000 km2 (25% of all Africa), from the Atlantic to the Red Sea, within Algeria, Tunisia, Libya, Egypt, Sudan, Chad, Niger, Mali, Mauritania and Morocco. It is south of the folded Atlas.

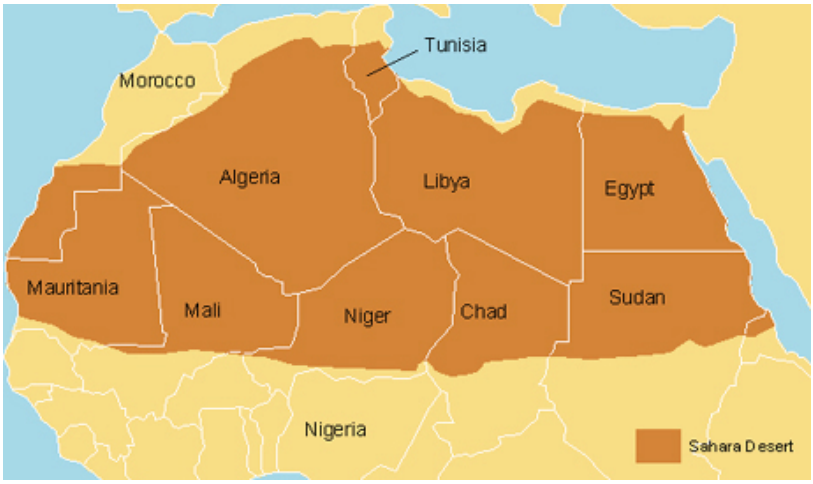


Figure 1: Sahara map in North Africa

But French oil exploration was carried out only in Algeria, Tunisia and Libya.

-Sahara Sedimentary basins and first geological surveys

From the southern outcrops of the Hoggar there are several structural highs from east to west:

Tihemboka arch/Atchan uplift; Amguid spur/Hassi Messaoud (El Biod) high ; Idjerane spur/AllalHigh/Tilremt uplift; Ougarta & Azzene ridges

Towards the north these highs are blocked by the folded Atlas mountains.

Between these highs there are many basins: Illizi and Ghadames (now called Berkine in Algeria and Ghadames in Libya and Tunisia); Mouydir and Oued Mya; Ahnet and Timimoun (Gourara); Reggane & Tindouf.

In Libya the Murzuk basin is east of the Tihemboka arch.

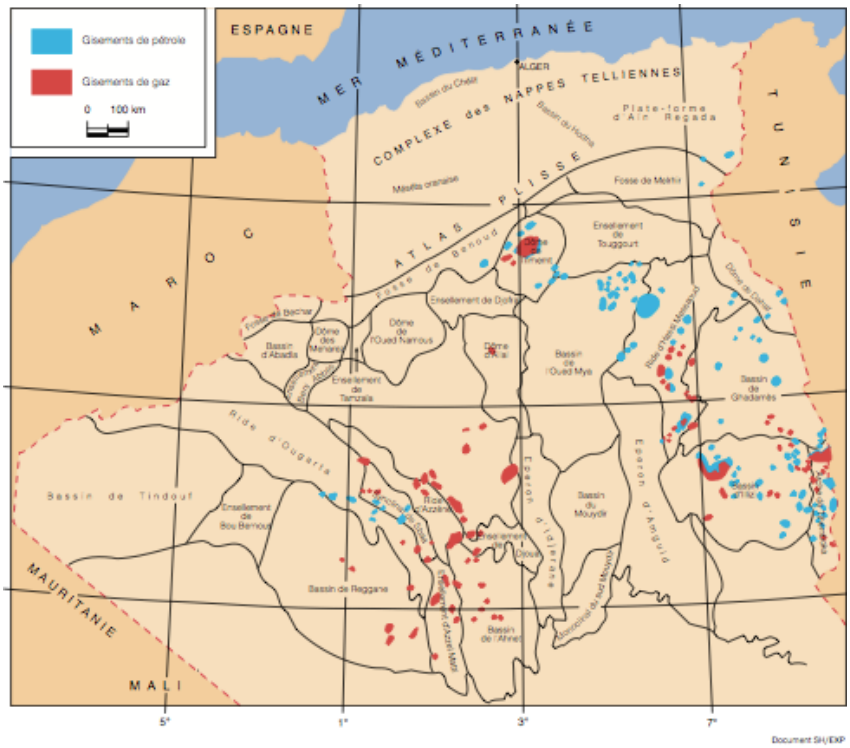


Figure 2: Geology of Algeria from Sonatrach (SH) 2007

-First geological surveys

The French geologist Alain Perrodon, who was greatly involved in the Algerian exploration, has beautifully described in his book 1985 "Histoire des grandes découvertes petrolières" the history of the greatest petroliferous sedimentary basins in the world. Another important actor in the Sahara the Swiss geologist Willy Bruderer (1889-1986) has described his hunt for flares in his 1985 book "La chasse aux bougies".

Since antiquity two seeps were known in Algeria : one in the north of the Cheliff at Aïn-Zeft (oil spring) and the second at Sidi-Aîssa called tar creek. In 1892 an English company drilled few wells giving few barrels.

Oil was found early before 1950 north of the Atlas mountains in tiny fields: in Morocco with Tselfat 1919, Ain Hamra 1924, Bou Draa 1935 (W.Bruderer), Baton 1947, Tisserand & El Menzeh 1948, Oued Mellah 1949 and in Algeria with Ain Zeft 1910, Messila 1914, Medjila 1922, Sebka Ben Ziane & Tafraoui 1941, La Senia & Echmuhl 1943, Oued Gueterini (3 Mb produced) 1949 closed to Sidi Aîssa

-Conrad Kilian

In the Sahara Conrad Kilian (1899-1950) was the first geologist to describe in 1922 (Academy of Sciences) the Silurian graptolite shales in the Tassili of Ajjers and to guess the huge potential of the northern Sahara.

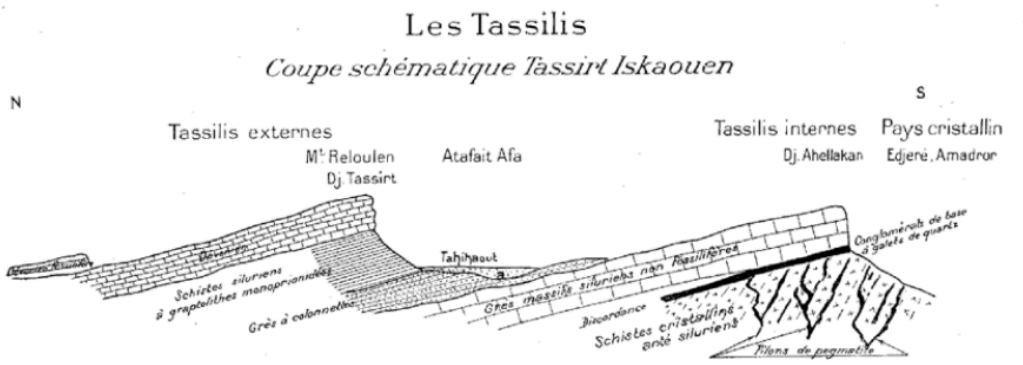
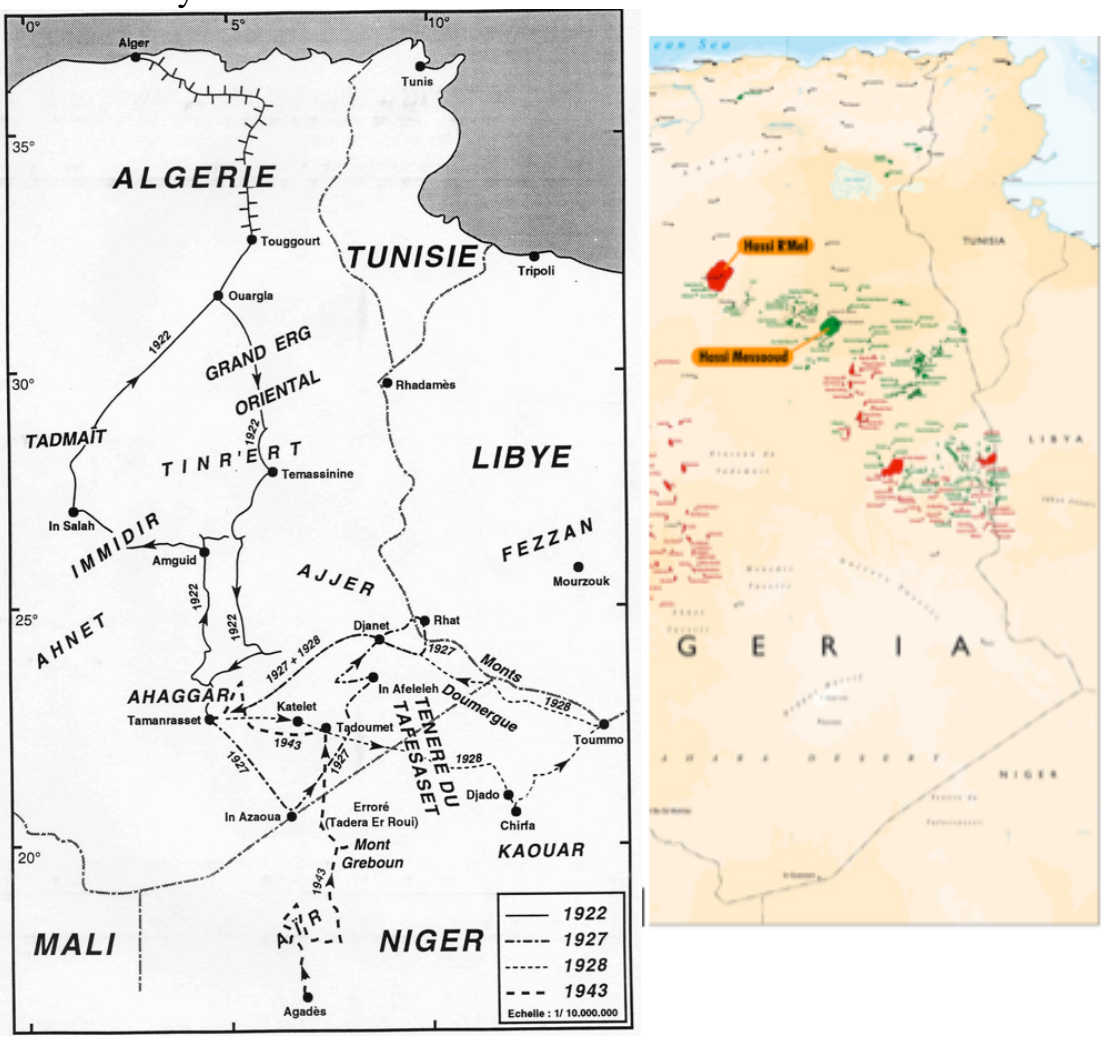


Figure 3: Tassilis outcrops Kilian 1922

Son of Wilfrid Kilian (geology professor in Grenoble), his first exploration survey was financed by a rich Swiss settler in Algeria to find emeralds as described in the mythic Garamantes emeralds (Herodote, Pline, Colonel Flatters): he did not find any emerald, but he described the Paleozoic formations. Monod concluded in 1974 that there were no emeralds in the Sahara, but beautiful green amazonites with mines in the Libyan desert in Garamantes country.

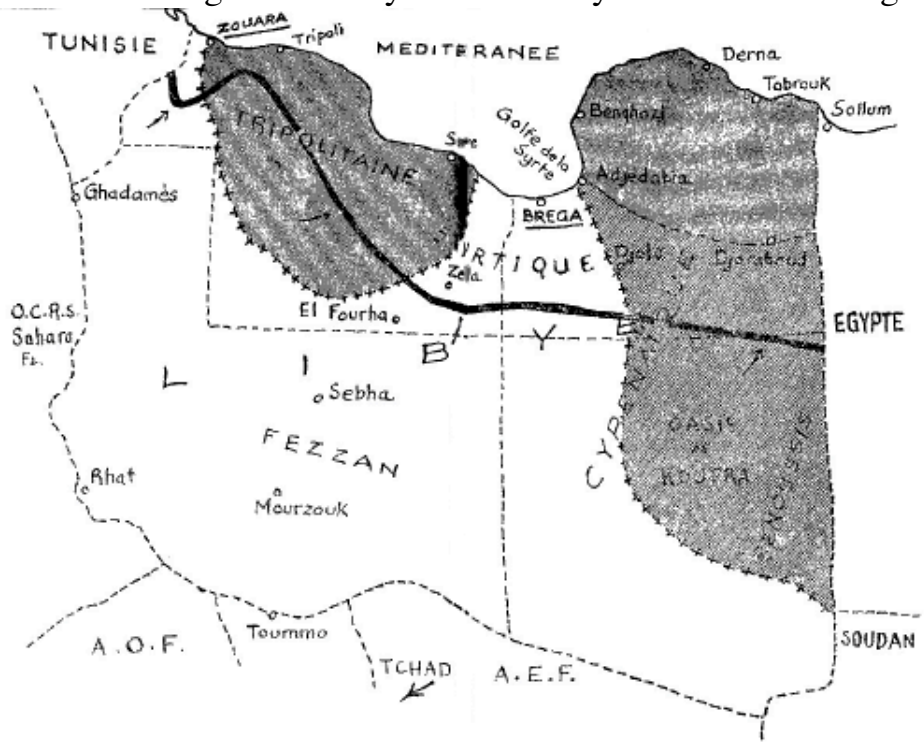
Conrad Kilian did several surveys (1922, 1927, 1928, 1943) in the Touareg country in Algeria and Libyan as shown in the following graph

But Kilian's surveys were south of the Illizi fields and south east of the Ahnet fields.



Figures 4: Conrad's trips from Lelubre 1992 and oil & gas fields map (The Petroleum Economist 2009)

Despite that he did not explore the areas of the present known fields, he was claimed to be the father (or the prophet) of the Sahara oil by many articles, books (Fontaine 1959, Boissonnade 1971 &1983 & 1990, Lelubre 1951 & 1992) and videos (Decaux 1980). He wrote several short papers on geological matters, but his goal was to declare French territory, as a "sovereign explorer" (like the scientists sent by Napoleon in Egypt), any place not yet explored or claimed by any white country (res nullius). Kilian second exploration was financed by his leg from his father and he was leading a team of armed Touaregs on camels and an equerry-banner holding his flag: "avec Kilian toujours vaillants". He was megalomaniac, but with an air about him.
In the Libyan Fezzan he declared the mounts "Doumergue" under the name of the French president. He wrote papers to many politicians from Doumergue to General de Gaulle advocating that the Fezzan should be French after the conquest of Libya by the General Leclerc in 1942-1943 from the Chad. But politicians like Laval had already made a deal with Italy about the Fezzan (Morocco to France and Libya to Italy). But General Leclerc seemed to be convinced by Kilian proposal of a deal where the Fezzan (with an opening to the Mediterranean sea towards Brega) to France, Tripolitania to England and Cyrenaic to Italy as in the following map.



— — — Frontière de la Libye. ▬▬ Limite des conquêtes de l'armée Leclerc (42/43) venant du Tchad.

+ + + Projet Kilian de Fezzan Syrtique. Les abandons des territoires au Sud de la ligne Leclerc devaient être consentis en échange de la partie de Syrtique au nord de la ligne Leclerc Pour doter le Fezzan d'un débouché maritime avec le port de Brega.

PROJET DE PARTAGE DE LA LYBIE *a) les parties hachurées horizontalement devaient revenir à l'Italie ; b) partie hachurée obliquement à la Grande-Bretagne ; c)le restant devait constituer la Fezzanie française.*

Figure 5: Kilian's project of French Fezzan

The project of French Fezzan was included a good part of the oilfields (Zelten) of Sirte, a part of the Tripolitania oilfields (small reserves) and the oilfields of the Murzuq basin.
Leclerc did order that a military ship to be sent to Brega but his plane exploded close to Colomb Bechar in 1947. It was rumored not to be an accident but an explosion with one unexplained extra death. Kilian accused the Intelligence Service to attempt to kill him. On 22 November 1948 he deposited a sealed envelop (to be open only 10 years later) at the French Academy of Science. This letter was rumored to content all his secrets desired by many foreign countries. In 1947 Kilian has met most of the French geologists working on the Sahara in particular Lafitte and Tenaille. In January 1948 Willy Bruderer did a presentation claiming, despite the lack of seeps, the high potential of the Saharan reservoirs in comparison to large oil basins in the US and Russia. In 1948 SNREPAL and CFP decided to explore the northern part of the Sahara.
In 1950 Kilian had nothing more to propose and he was tired and poor? He was found hanged and his death stated as a suicide, but many newspapers claimed that it was a murder, accusing the Intelligence Service. Most papers on Kilian mentioned the "bomb" of the 1948 sealed paper, which was opened in 1951 at the request of his heirs and published in 1957 in the Academy of Sciences in petrography with the title "oil and copper in the central Sahara". In this very short paper, he was forecasting oil from oil shale in the northwest of Mouydir (where presently no discoveries) and talking about seeps in the Djebel Idjerane, but Tenaille (Perrodon 1980) described this seep as a sulfur spring with iridescence from iron oxide. Same thing for the copper. This sealed paper was a wet cracker!
The main merit of Kilian on the Sahara oil potential was to foresee the huge potential of the Silurian source-rock and to tell the politicians about it. But oil is not found by politicians!

-real fathers of the Sahara oil

The plain French geologists who were really the fathers of the Saharan oil and gas are Menchikoff, Follot, Lelubre, Meyerhoff, Lafitte, on the university side and Tenaille, Bruderer on the oil companies side, convincing their management to spend large investments in the Sahara.
Alain Perrodon was active in advising exploration within BRP and SNREPAL but also reporting exploration in AAPG in particular "Petroleum developments in Africa" under HD Hedberg and in several books.
The 19th International Geological Congress was held in Algiers in 1952 (under Charles Jacob & Robert Lafitte) with more than 1100 members.

-Oil & gas Companies exploration in the Algerian Sahara

In 1947-1948 ESSO concluded that the Sahara has little oil interest. There are no oil seeps, and only few outcrops in the south. The large distance to the coast obliges to find very large oilfields.
Bruderer 1985 mentions that a water well in Illizi basin found oil shows in 1948 in Carboniferous at 260 m, being the first indication of oil in the Sahara.

SNREPAL started exploring the Sahara since 1947. After a joint geological survey in 1948 with CFP, they agreed to share exploration in 1951 on 12 permits requested in 1950 on the basis 51/49 %. The choice of the operatorship on the check board permits was decided playing dice (REPAL even, CFPA uneven)! The permits were attributed to the association REPAL/CFPA on October 1952. The terms were tough: release of 50% after 5 years (1957), another 25% after 10 years.
Geophysical surveys stated in 1952 with refraction and gravimeter
In 1953 Shell did the same with the BRP with an association 65/25 % with the creation of CPA and CREPS
The actors in the following map in 1956 were with the number of permits and area:
-SNREPAL = Société Nationale de Recherches et d'Exploitation des Pétroles en Algérie 50% Algerie; 548.45 % BRP; 1,55 % Cofirep; 12 permits; 202 829 km2
-CFPA = Compagnie Francaise des Pétroles Algérie 9 permits; 124 800 km2
-CREPS = Compagnie de Recherche et d'Exploitation de Pétrole au Sahara 65 % BRP, 35% Shell, 11 permits 138 967 km2
-CPA = Compagnie des Pétroles d'Algerie = 65 % Shell 65%, 35 % SOGERAP, BRP, Finarep, Cofirep; 7 permits; 167 871 km2
-SEREPT= Societe de Recherche et d'Exploitation des Pétroles en Tunisie = Tunisia government & CFP

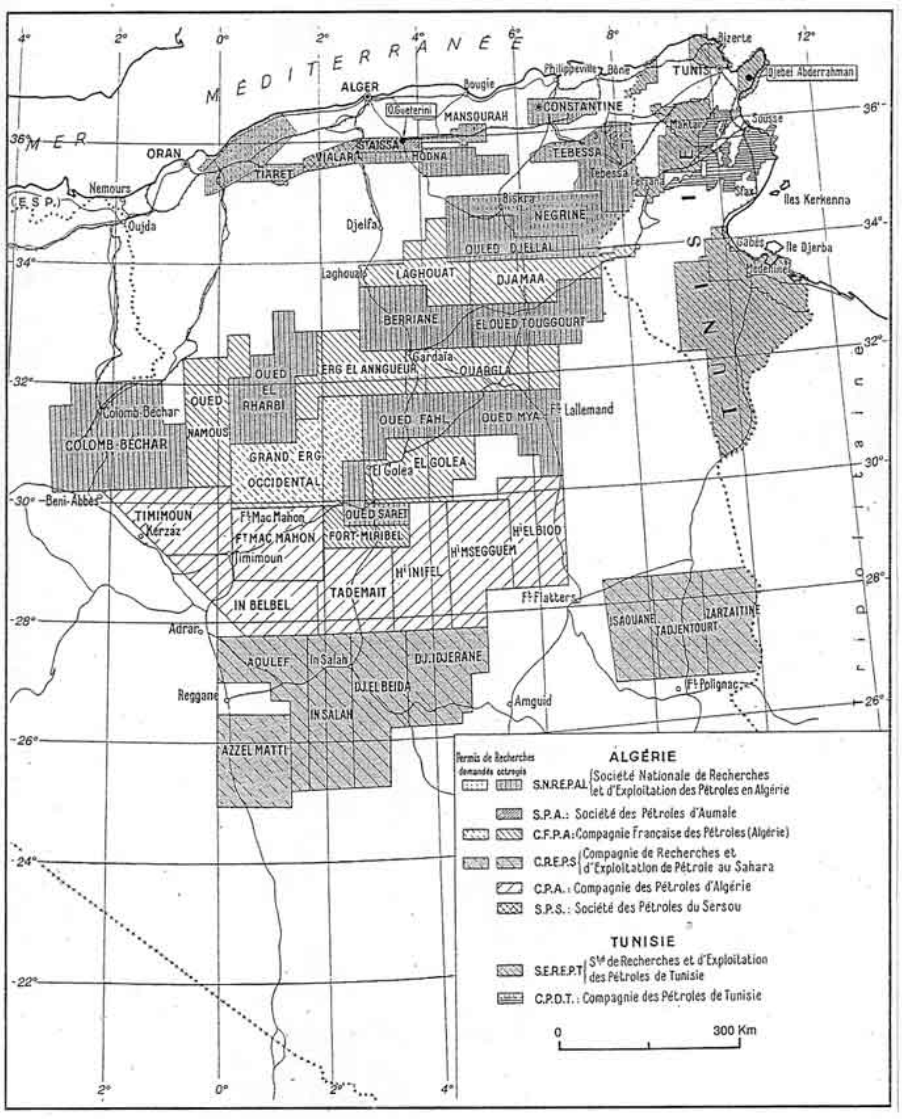


Figure 6: Permits in Algeria and Tunisia in 1956 (from A. Morange, A. Perrodon et F. Héritier).
The terms of the permits in this unexplored wild country were tough obliging to release 50% of the area after 5 years, being 1957and another 25% in 1962.
The independence of Algeria in 1962 changed the spirit of exploration with the following map. All oil foreign assets in Algeria were nationalized in 1971.

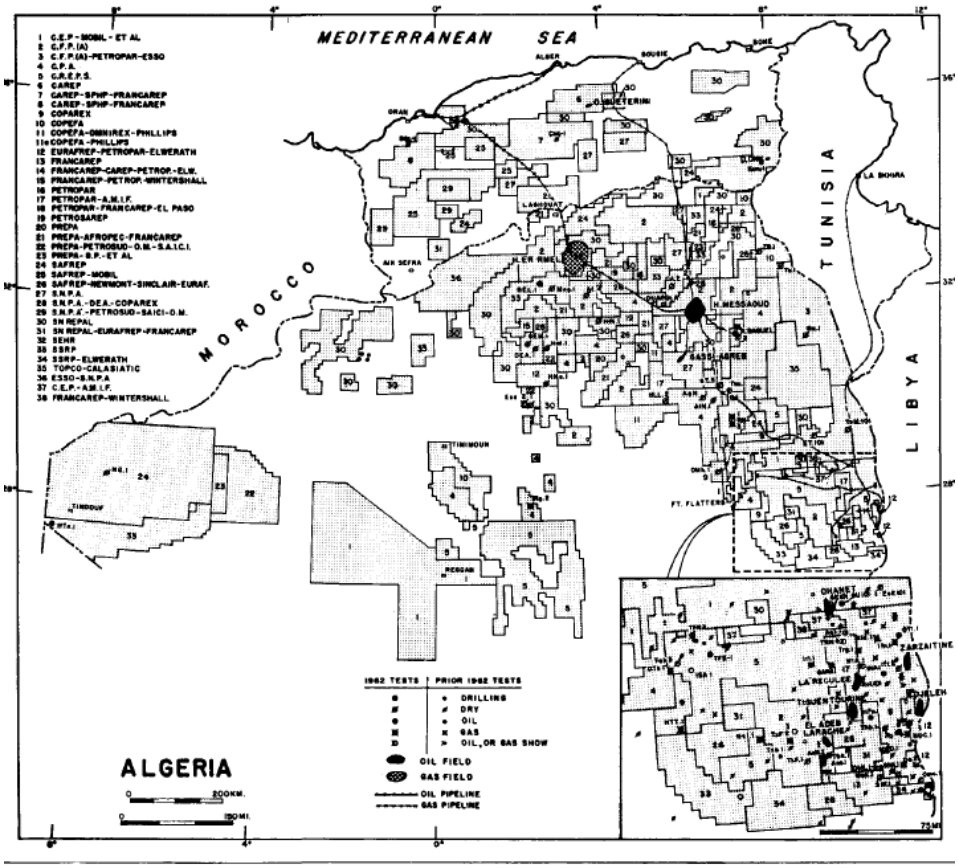


FIG. 4

Figure 7: Permits in Algeria in 1962 (Perrodon AAPG)

-**First discoveries in Algeria**
In the south, CREPS discovered gas in 1954 at Djebel Berga (Ahnet basin) and oil on 1956 at Edjeleh. But it was to far to be developed immediately.
In the north REPAL and CFPA after drilling twenty dry stratigraphic holes (only Berriane 1953 with oil & gas show), started to drill in January 1956 a well at Hassi Messaoud on a refraction seismic structure.

-**Hassi Messaoud field**
Gravimetric maps were difficult to interpret and first reflection seismic surveys were very poor in the North with poor penetration because the large thickness of dry sands in surface and of evaporates in Triassic formations. At the recommendation of H. de Cizancourt refraction seismic was chosen and high velocity (about 6000 m/s = basement) markers were mapped. The first published map was by Balducci & Pommier in 1970. CFPA exploration team was headed by Claude de Lapparent with Gilbert Pommier as chief geophysicist (I worked under him).
The structure of Hassi Messaoud (Pommier's egg) was mapped from several refractions lines centered around the water well Hassi Messaoud being the location of

the main camp of the refraction party. The wildcat Md1 (Hassi Messaoud Sud 001) was located near this water well.

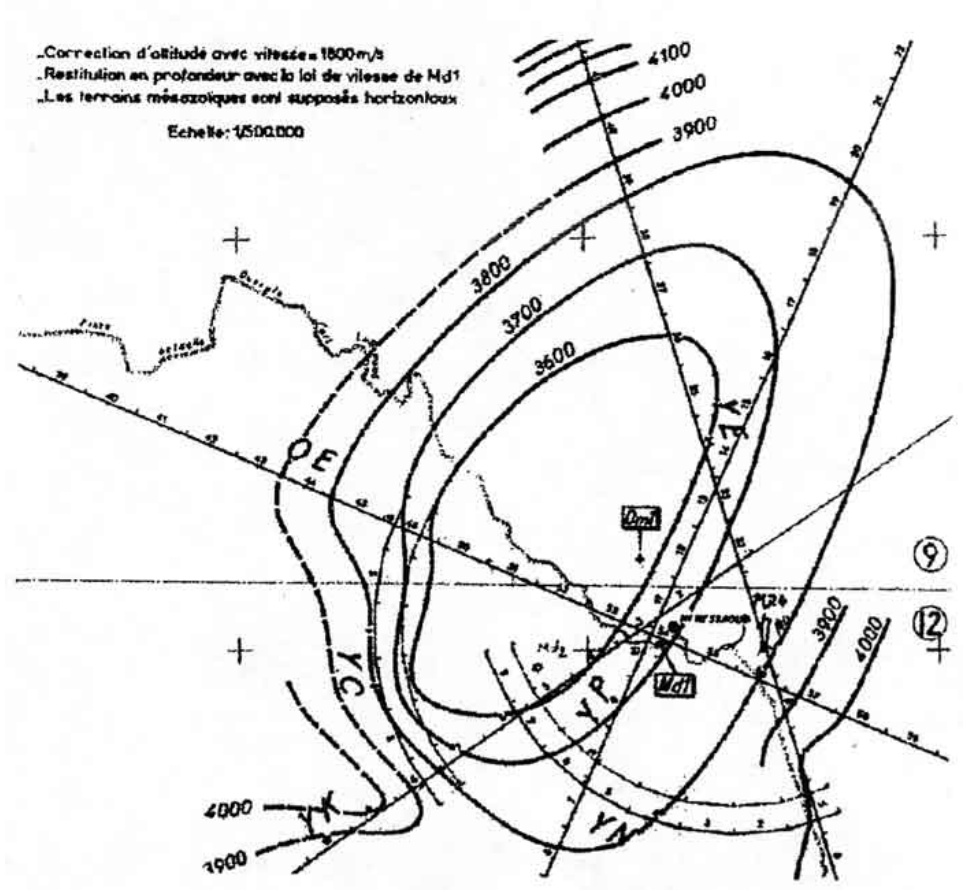


Figure 8: Hassi Messaoud structure interpreted by G. Pommier (isobaths of 5900 m/s marker) in the proposal of OM1 well from A. Combaz 2002

In November 1956 Md1 found oil in a sandstone below a thick Triassic salt. This reservoir was reported in the AAPG Hedberg report for 1956 as "*at 3330 m (10 925 ft) a bed of Triassic sandstone of some 140 m (459 ft) which on tests has yielded important flowing production of light oil of excellent quality*.

But AAPG Hedberg 1957 reported the drilling of Md2 which *"passed through the Triassic at 10 915 ft. into the Tigillites quartzites resting at 11 040 ft on a series of coarse sandstones comparable with the productive sections of MD-1.These sandstones, impregnated for a thickness of 358 ft, were penetrated to 12 582 ft, at which depth they were found to rest on granite. This section permitted the assignment of the "sandstone of Messaoud" to the Cambro-Ordovician and has thus opened new objectives for petroleum exploration in all this region of the northern Sahara*.

Andre Combaz (CFPA well site geologist) told very well in 2002 the story of the Algerian discoveries in the 1950s.

The above seismic refraction structure can be compared to the structure from the wells

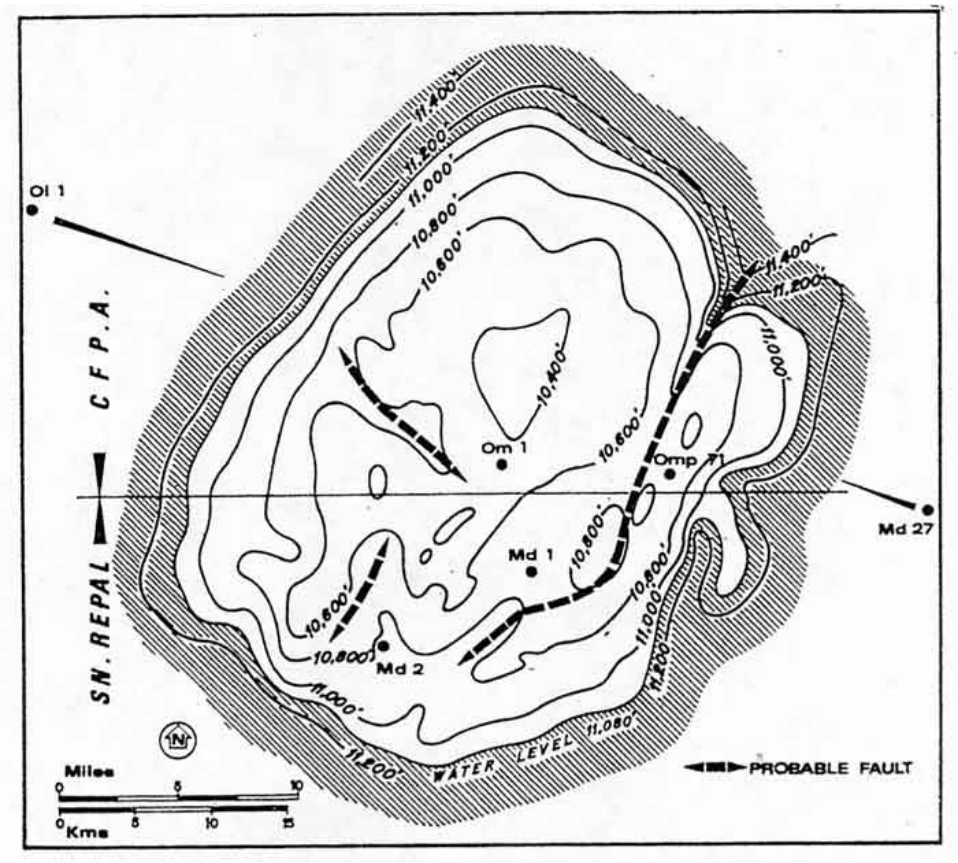


Figure 9: Hassi Messaoud field : isobaths of the reservoir in 1967 with the water level from Combaz 2002
Oil production at Hassi Messaoud started in 1958 and peaked in 1972 at 600 kb/d and was 400 kb/d in 2010.

It is funny to realize that from the knowledge from the southern outcrops geologists knew that the source rock in the northern Sahara was the Silurian and they thought that the reservoirs should be only the reservoirs above Silurian source-rocks and not reservoirs below: it is why, when finding oil in Md1, they thought that the reservoir was Triassic when in fact it was Cambrian. The funny part is that if the water well had been at the location of Md2 the first well would had been drilled at this location and the geologist would have recognized the Tiggilite quartzites and recommended to stop drilling with the thinking that oil could not be found below the source rocks. In this case the future of Algeria would have been quite different because already 20 dry wells have been drilled.
The geological profile across Hassi Messaoud (Salle & Debyser 1976) from Haoud Berkaoui (1965) to Rhourde el Baguel (1962), shows very well that Hassi Messaoud structure was already present at the time of Hercynian unconformity and the Silurian source-rock was eroded, being present only on the west and on the east, being at this time immature, like a oil shale. It is only when recovered with a thick layer of salt and anhydrite that the oil kitchen was reached and oil migrated from west and east through the Triassic sandstone to the Hassi Messaoud Cambrian anticline, which is a syncline at the Aptian horizon, which is the only reliable event followed by the

reflection seismic. Rhourde El Baguel structure cannot be seen easily on reflection but on aeromagnetic survey.

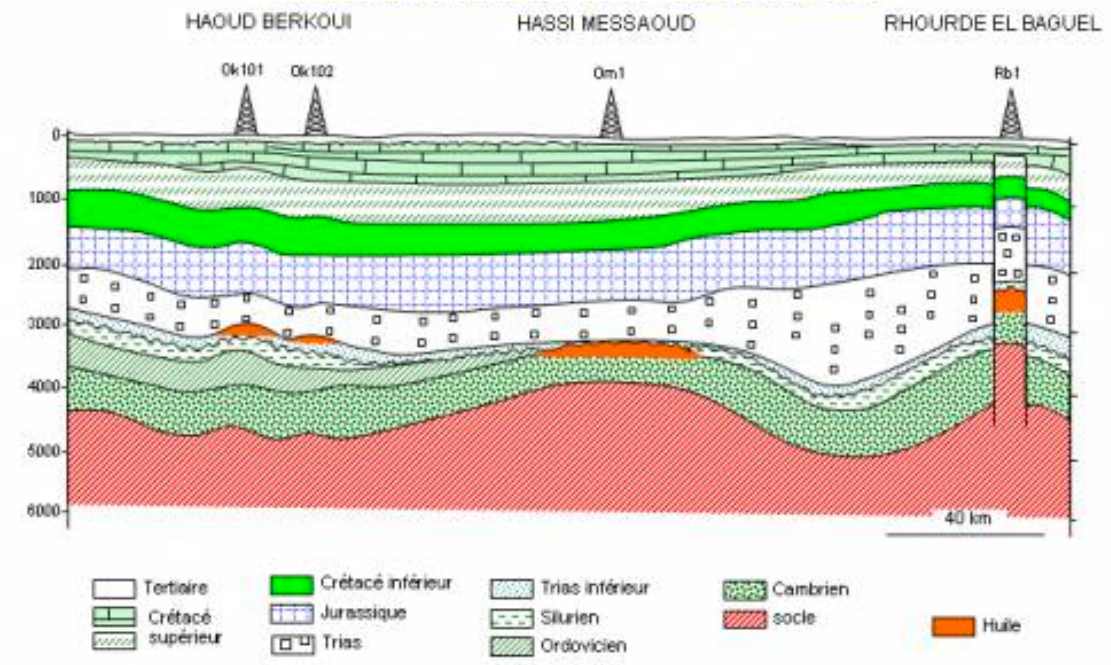


Figure 10: geological profile across Hassi Messaoud (Salle & Debyser 1976)
Hassi Messaoud structure cannot be seen on reflection seismic reflection surveys because the poor quality of the events below the thick salt and the very low angle of the large structure.

In my 2000 French paper (there is a updated 2005 translation "Memories and thoughts on 50 years of oil and gas geophysics") I proposed to pay a lunch in the best Paris restaurant to anyone able to show me Hassi Messaoud structure on a reflection profile without the help of wells. One CGG manager told me that he was going to Algiers soon and that he hoped to bring such profile. But few months later he told me that he was unable to find such data. My bet is still good!
In this paper I remind to the young explorers that 60 years ago there was no GPS and surveying was a very important part of geophysics, starting with astronomic point. It was necessary to leave markers (steel pipe exploded in the ground in order to be hard to be picked by nomads) for drillers to find the seismic lines.
For refraction shooting we used fertilizer mixed with fuel and prime on surface or in hole. For a better interpretation I measured the anisotropy around Hassi Messaoud by shooting up to 4 tonnes on surface for a maximum offset of 6000 m with a geophone in the granite at 3700 m (Dunoyer & Laherrere 1959). The anisotropy (horizontal velocity over vertical velocity) in sandstones is 1; in salt 1.00 to 1.05; in limestone 1.08 to 1.17 and in anhydrite 1.15 to 1.20.

A queer thing on Hassi Messaoud is found now on Internet on the origin of the name. For 50 years since its discovery it was well known that the origin was from the water well (closed to Md1 and located at the main camp of the refraction seismic party) which is translated by "*lucky well*" because Hassi means well and the surname Messaoud (or Masoud) means *fortunate, prosperous or happy*. The military Roger

Alloncle (URM33) reports that the active water well was built, 50 m from the old camel dry well, by the French Legion when working in the area before the 1956 discovery and several web sites (Remy Casals 1969) confirm that the well a has a door with an arch.

Figure 11: Hassi Messaoud water well drilled by the nomads Alloncle 1960
This water well built by the French soldiers was located on a barren place and I took a shot in May 1958 with my wife (wifes were not allowed on the drilling base but I was a geophysicist staying outside).

Figure 12: Hassi Messaoud water well and my wife Mai 1958 : only desert around
But it appears that an older well (Pierre Jarrige) was drilled by the French Legion in the 30s and the one above was built by the Bataillon d'Afrique

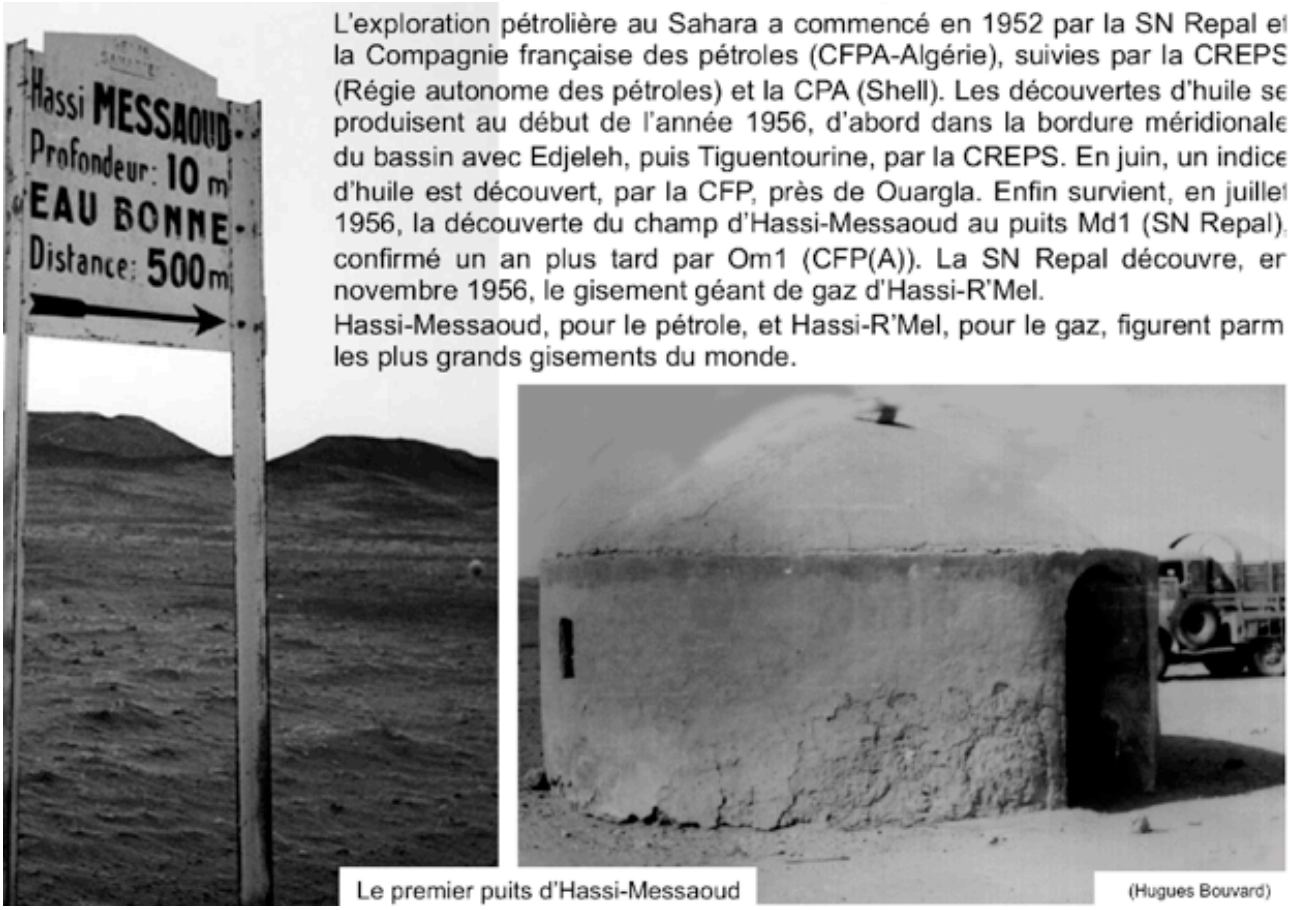


Figure 13: Hassi Messaoud water well in the 30s by the French Legion

The French map IGN 1943 1/200 000 Fort Lallemand reports two Hassi Messaoud wells one on the oil discovery and another 28 km east. The same map 1/250 000 can be found in the US at http://www.lib.utexas.edu/maps/ams/north_africa/txu-oclc-6949452-nh32-1.jpgand and also on the German 1942 map 1/500 000

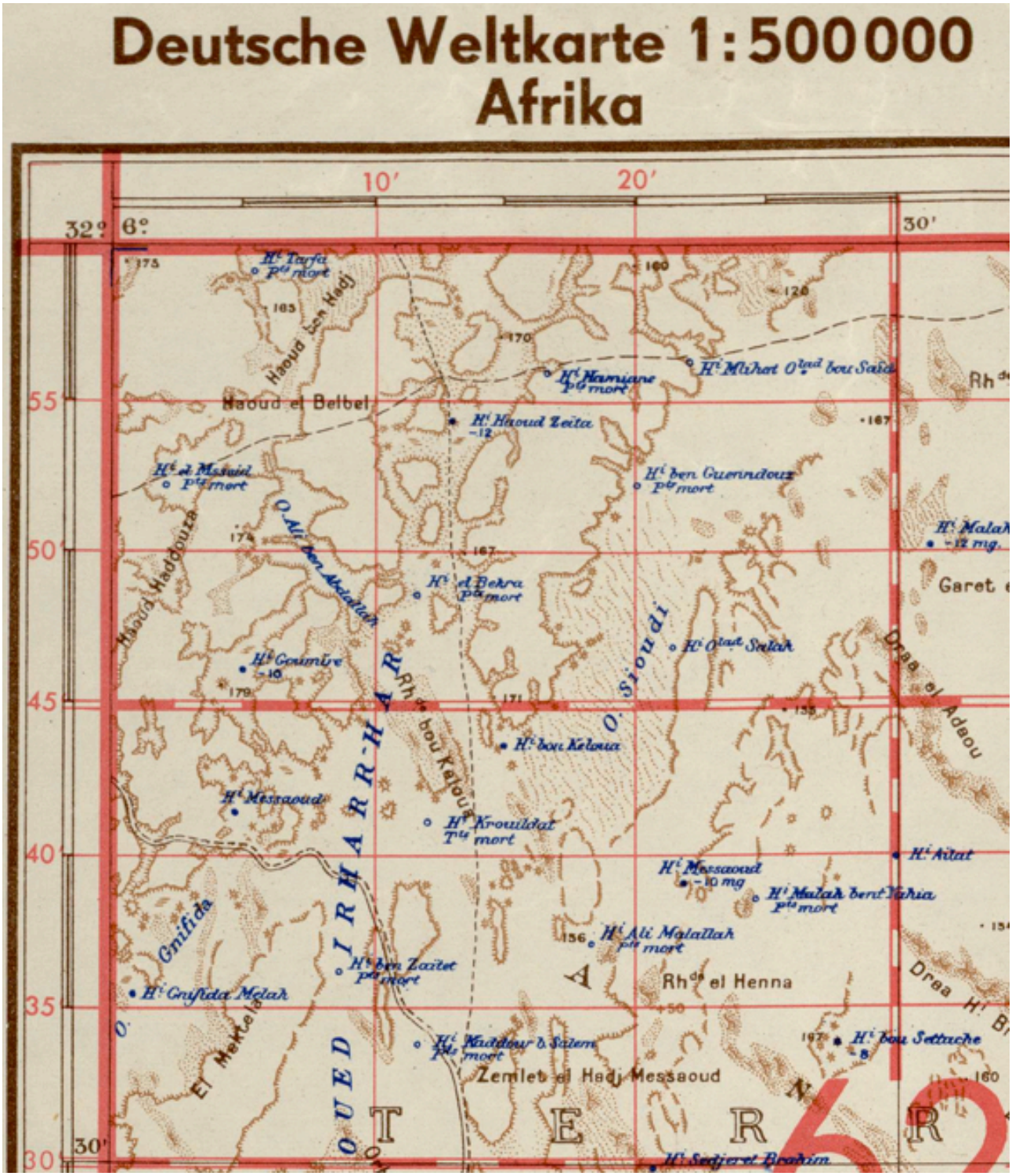


Figure 14: German 1942 1/500 000 map (from IGN) showing two Hassi Messaoud wells: the eastern one at 10 m and the western one with no depth close to the discovery

On the recent satellite maps it is hard to find the historical well because version varies

Figure 15: Hassi Messaoud town from Google earth

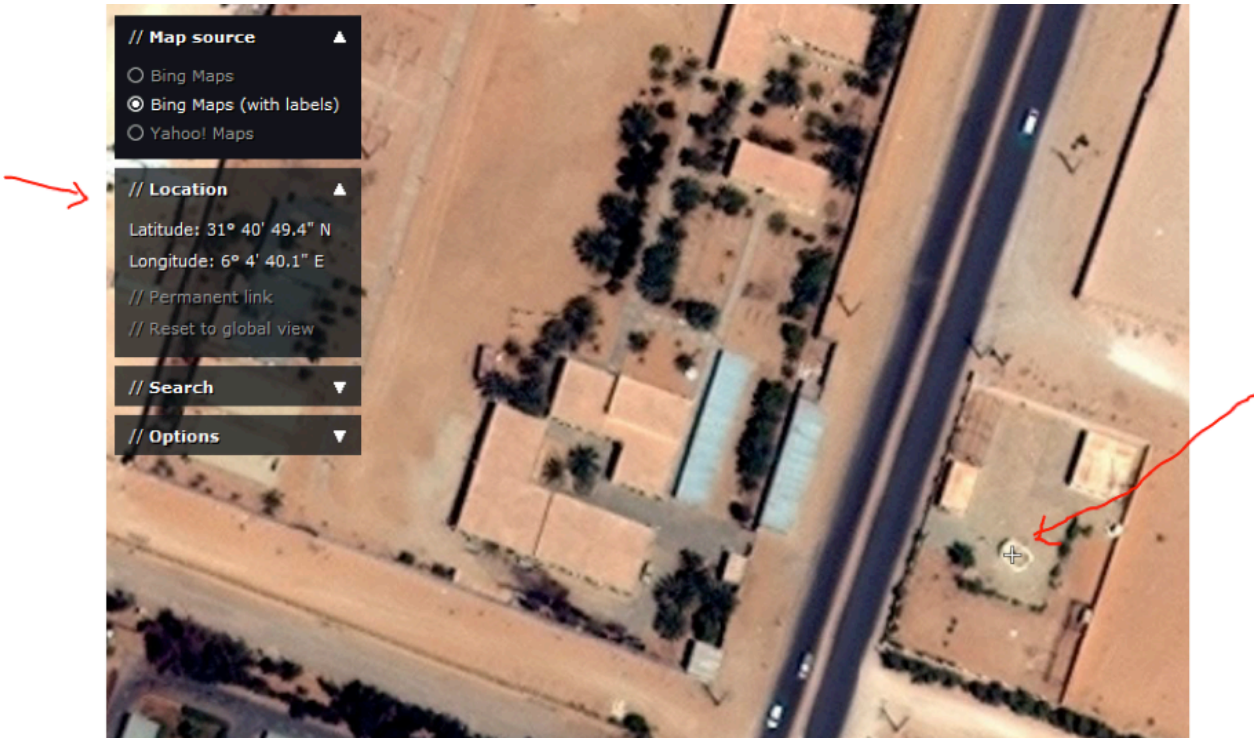


Figure 16: Hassi Messaoud water well from Google earth as shown below

But lately Internet Wikipedia says that the water well was drilled in 1917 by Messaoud Rouabeh (or Messaoud Ben hadj Rabah) using a goat horn and found a strange liquid which was analyzed in France in 1917 and one site (http://www.yacinezaid.org/2011/10/les-enfants-de-hassi-messaoud-en-colere.html) says that it was oil. The picture of the so called 1917 water well is a fake, the real nomads well is on figure 11 without wall around.


Figure 17: The first well dug in Hassi Messaoud by Messaoud Rouabeh in 1917 from on Dec 2010 from Wikipedia http://en.wikipedia.org/wiki/File:Messaoud_Water_Well.jpg http://commons.wikimedia.org/wiki/File:Messaoud_Water_Well.jpg

So, from the web, oil was found in 1917 on the location of Md1 by a well driller named Messaoud looking for water with a goat horn on few meters: it is a bad joke! Furthermore the shown well is within the new town and is different (no arch) from the one existing in 1958: it is a crockery and the heirs of the so called oil finder claim their right on the place and they are many (600)!
Hassi Messaoud is now a town of about 50 000 people!

It is a pity that there is not a reliable paper on the history of Hassi Messaoud on Sonatrach site! Wikipedia is unreliable!
Looking for data on the web has the same poor success ratio as looking for oil in frontier areas (10%) where most of discoveries are uneconomical.

Refraction data was mapping the basement allowing the discovery in 1956 of the oil giant Hassi Messaoud (10 Gb) and the gas giant Hassi R'Mel (100 Tcf & 2.4 Gb condensate), but it was necessary to map also the Mesozoic formations and also the Hercynian unconformity. Reflection surveys were then carried out

-**Reflection seismic**

In the northern Sahara, the poor quality of the reflection surveys is due mainly to the thick dry sand on surface and to the thick layers of Jurassic anhydrite & salt, the best reflector is the Aptian = dolomitic layer of 20 to 30 m.
In my 1961 article on synthetic seismograms I used velocity logs (CVL) from 12 wells (4 from Hassi Messaoud and 8 wells from Anngueur) to study the importance of multiples. The Aptian layer gives the strongest reflection event.
Many experiments on the source and on the geophones were attempted and the result was to get large area (about one hectare =100 m x 100 m) both for the source and for the geophones (up to100 holes per shot and 100 geophones per trace) (Laherrere 2000)
But the best improvement was the use of magnetic recording (1957 Carter tapes) and the common depth point (CDP). Unfortunately it is hard to find on the web and on AAPG good examples of seismic profiles!

-**Saharan Triassic Petroleum System** (PS)

Oil was found first near oil seeps, then on surface anticlines and later on seismic anticlines and basin classification was first based on structural tectonic, but it was realized that anticline was not enough, oil accumulation needs the presence of; a source-rock, a kitchen for generation, a migration into a reservoir, a seal and last a trap. The first to speak about Petroleum System was Alain Perrodon (1980) and later Leslie Magoon (1987) & Wallace Dow (1994). The first one to quantify the generation of a PS was Gerard Demaison (1991). In the 1994 (Laherrere, Perrodon & Demaison) paper, most largest Petroleum Systems in the world were quantified and in Particular the Saharan Triassic. The area of the PS is 300 000 km^2 and the area of the kitchen 200 000 km^2 having generated 5000 Gboe.

This huge amount of oil & gas generated from the Silurian shale will be used by many to forecast an astronomical potential for shale oil and shale gas, forgetting about the energy return on energy invested!
The map of the kitchen for Silurian source rock shows two kitchens with in the middle Hassi Messaoud where the Silurian has been eroded as shown on figure 9.

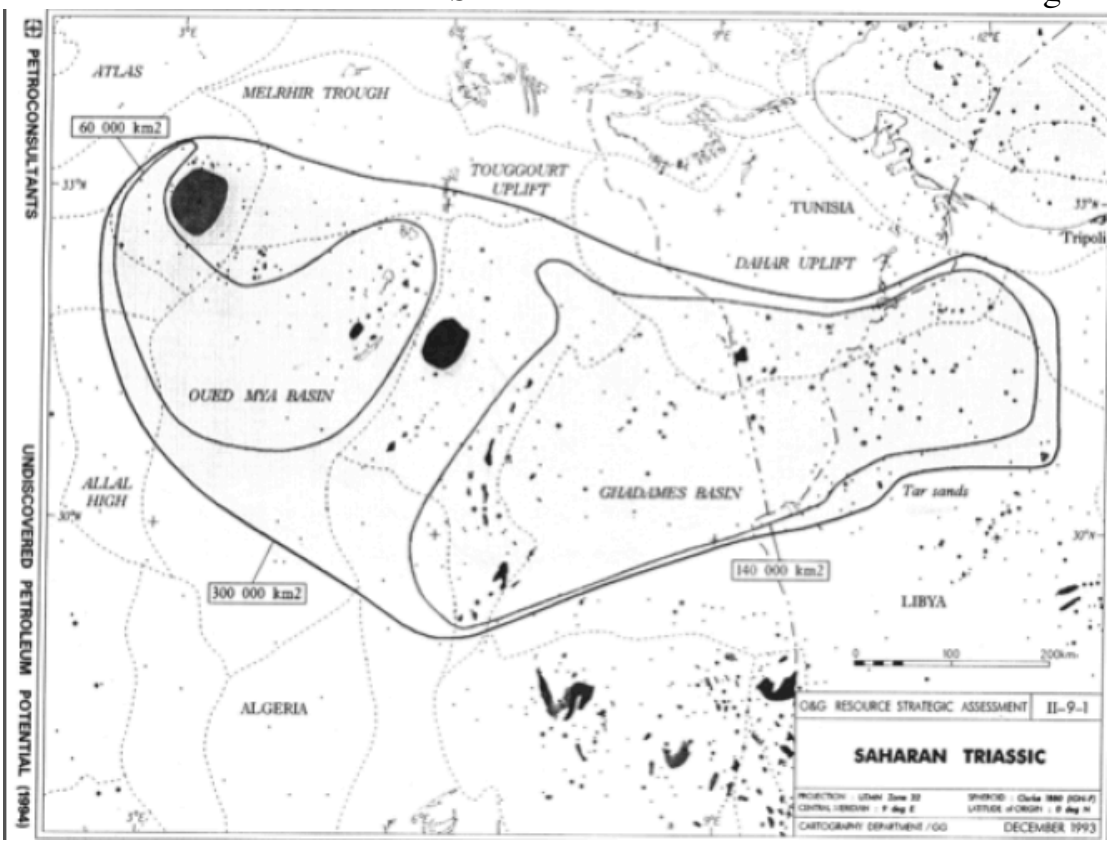


Figure 18: Saharan Triassic petroleum system map and two kitchens from Laherrere, Perrodon, Demaison 1994.
We were puzzled by the dissymmetry of the size of the fields, with two supergiant being Hassi Messaoud (10 Gb) and Hassi R'mel (100 Tcf) on the western part of the PS and only small fields in the eastern part. We searched how to explain this lack of large fields on the eastern part and we found that the salt is absent on the Libyan part of the PS, but there are tar sands in the Cretaceous sands. Our explanation was that oil was not sealed by the salt and went to the tar sands. In fact when writing this paper a giant field was discovered at Ourhoud in Triassic sandstone reservoirs (TAGI) in the Berkine subbasin of the Ghadames basin in 1994. Total did discover Hassi Berkine (a smaller field) in 1984 on the block 404, which was relinquished in the hope to get it again, but later it was attributed to Anardako (where Sonatrach has 5% interest).

Sonatrach (WEC 2007) has mapped the thickness of the Silurian shales, showing the areas where it is eroded (light brown)

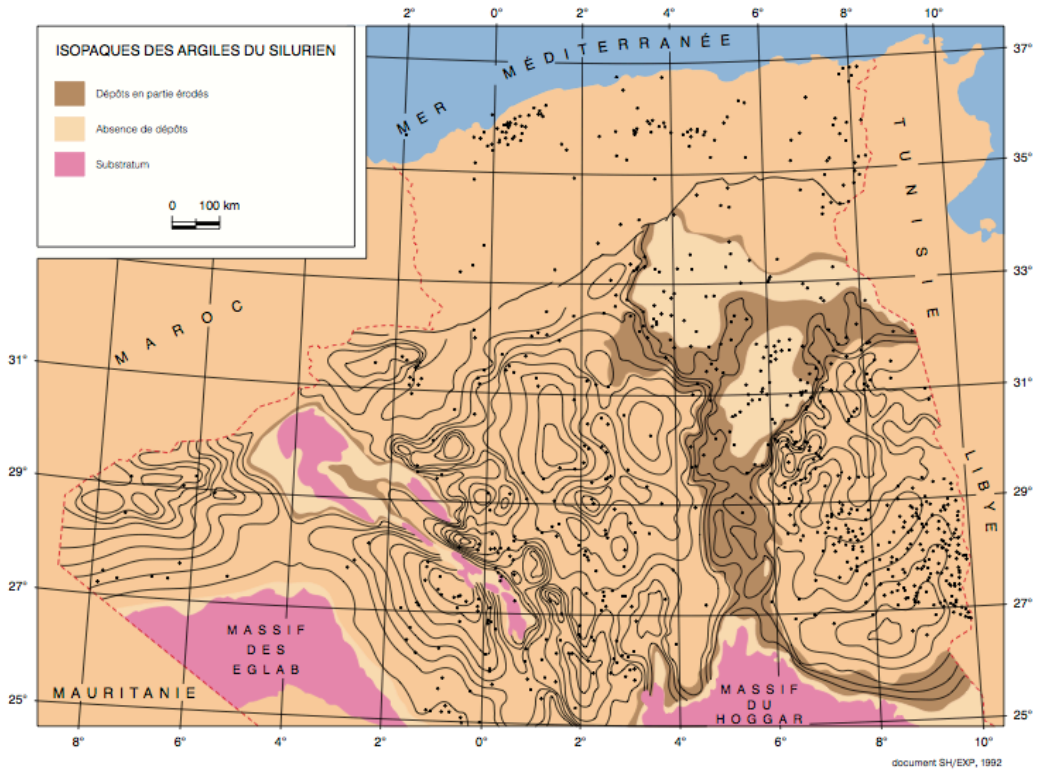


Figure 19: thickness of the Silurian shales SH WEC 2007

The habitat of the Saharan Triassic Petroleum System was compared (Laherrere 2000) with the Niger Delta and the Gulf of Mexico (GOM) on two different displays; parabolic fractal and lognormal. It is a concentrated habitat in fractal display when Niger Delta and GOM are dispersed habitats.

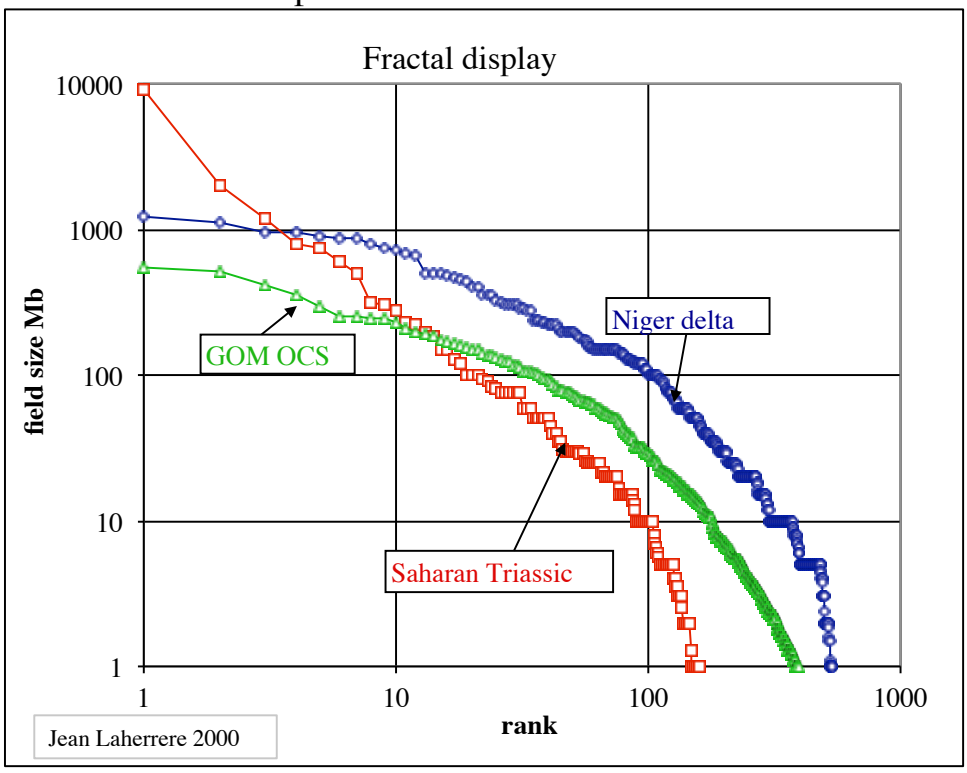


Figure 20: habitat of Saharan Triassic in fractal display compared to Niger Delta & GOM (Laherrere 2000)

In contrary Saharan Triassic fields distribution in lognormal display is similar to the Niger delta (only large fields are drilled), when the GOM is different with many small fields.

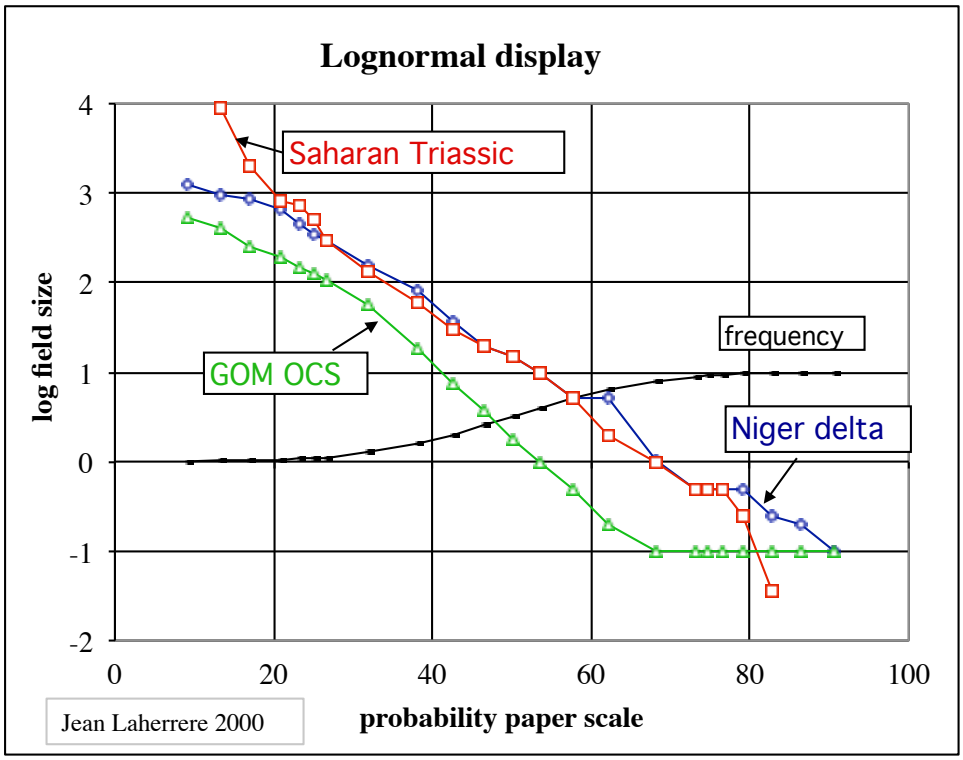


Figure 21: habitat of Saharan Triassic in lognormal display compared to Niger Delta & GOM (Laherrere 2000)

-Hassi R'mel gas field

Hassi R'Mel (100 Tcf on 2400 km^2 in Triassic sandstones) is the largest gas field in Africa but because condensate is not concerned by OPEC quotas, R'Mel condensate is produced at high rate (300 kb/d in 2010) with a large amount reinjected in the field which is the base of all Algerian gas production (in 2009 7 Tcf gross production and 3.4 Tcf reinjected.

It is very hard to get detailed gas production of Hassi R'mel from SH.

In 2010 SH president Abdehafidh Feghouli said that in the next 5 years more than 1 Gtep will be produced by better production from Hassi Messaoud and Hassi R'Mel which will represent more than half of the total primary production.

2012 SH income is about 70 G$ when the 2012 budget for expenditures of Algeria is 85 G$, financed for a good part by the French discoveries in the Sahara.

-Exploration activities in North Africa

The cumulative discovery of oil & condensate in volume and number by basin (Messaoud, Berkine, Oued Mya, Illizi) is given in the following graph

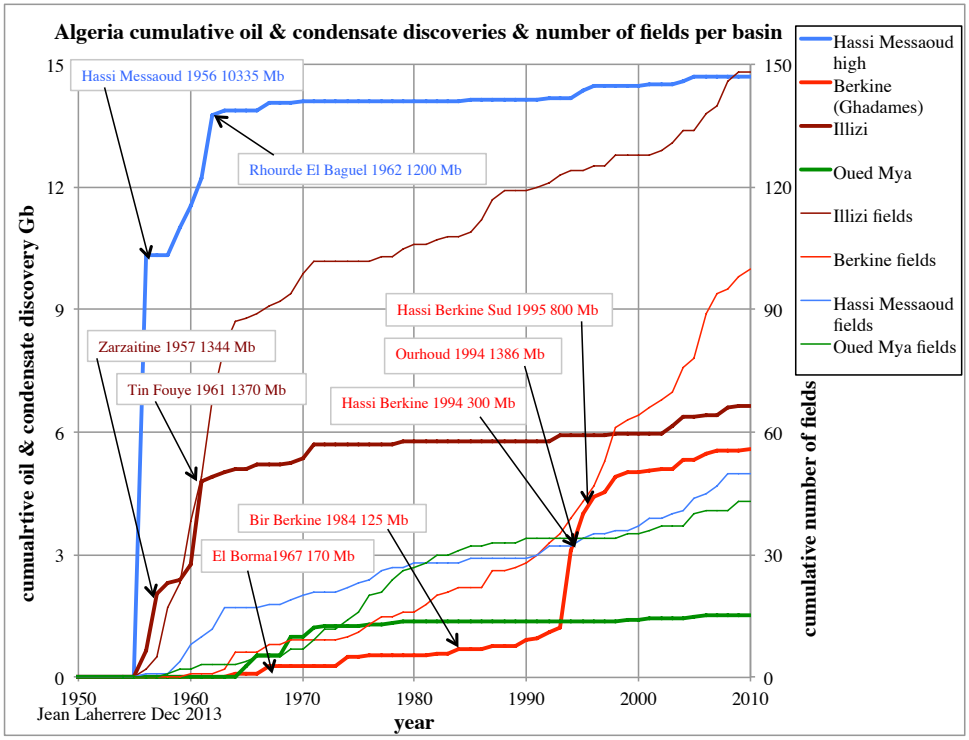


Figure 22: Algeria: cumulative discovery oil & condensate per basin

The cumulative number of New Field Wildcats in North Africa shows that Egypt started exploration in 1886, Algeria in 1910, Morocco & Tunisia in 1917 and Libya in 1957

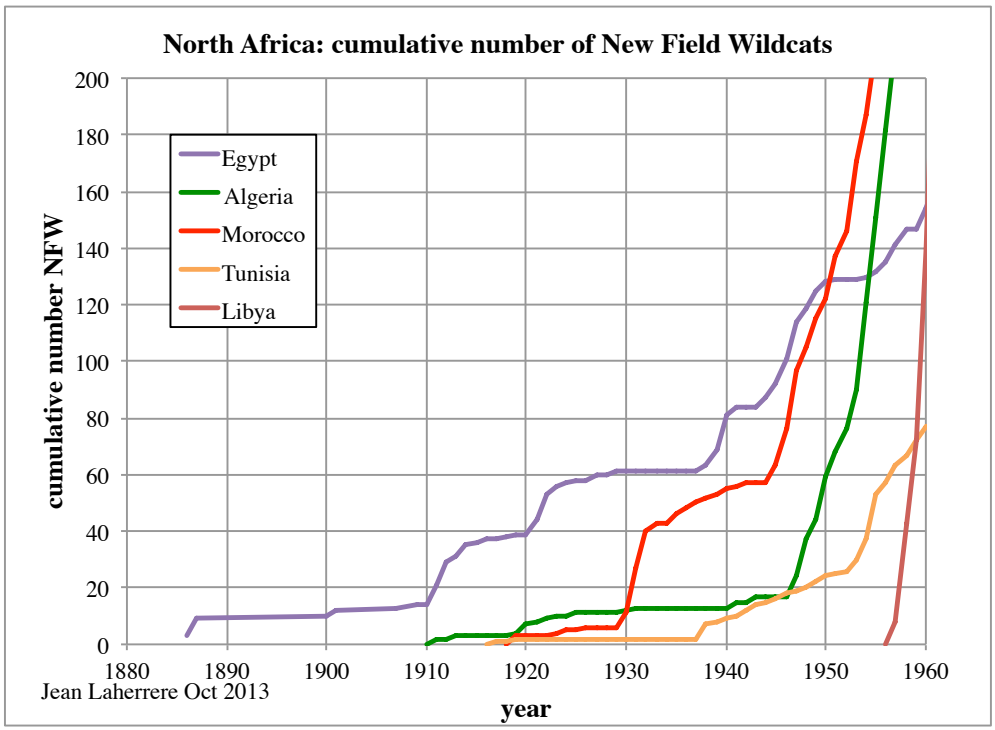


Figure 23: North Africa: cumulative number of New Field Wildcats 1880-1960

-Tunisia

SEREPT seismic survey in the Ghadames basin did not show any significant structure and they drilled 13 wells on Dahar uplift with only one tiny discovery at

Makhrouga oil in 1962 (dropped and developed by AGIP in 1983). Mobil which joined SEREPT dropped the association in 1962.
The only significant discovery in this basin was El Borma (750 Mb) in 1964 by SITEP a subsidiary of AGIP. El Borma is located at the only outcrops of Mesozoic in the Tunisian Ghadames basin, very close to the Algerian boundary. El Borma oil production started in 1966 and peaked in 1970 at 84 kb/d (9 kb/d in 2010).

-Libya
CPTL = Compagnie des Pétroles Total (Libya) was granted 8574 km2 in 1957 with concessions 23, 24, 49, 61. The geological team was headed by PF Burollet with J. Canaple, Ph Magnier, G. Manderscheid, D. Massa, B.Duval, R. Leflaive.
In the Ghadames basin CPTL drilled 17 NFW from 1958 to 1978 with 7 small discoveries mainly in the Silurian Acacus for a total of 56 Mb of reserves. Reflection seismic was good (no salt) and they were able to find small fields : it was a technical success but an economical failure. At end 2010 in the Ghadames basin there are 112 discoveries totaling 2 Gb and 3.6 Tcf. The largest field is Bir Tlacsin (NC004) now produced by the oil pipe coming from the Murzuk large fields.

-Windfall of the Sahara refraction seismic
H. de Cizancourt who was the boss of Bruderer when launching CFP into the Sahara was at the end of the 1950s managing CPF subsidiary in Canada. He asked help for shooting refraction to check if a surface anticline in the Franklin Fold belt in the Canada Northwest territories was also present in depth. I went from Algiers for 3 months in Calgary (quite a change in temperature) to supervise a refraction seismic party using only dog teams, skidoos and one helicopter with fertilizer shooting on surface. The anticline was also in depth but the well drilled in 1963 at Root River I-60 was dry.
After the success in the Sahara, CFP decided to explore in Australia the Simpson desert looking for Paleozoic reservoirs. We shoot a long line (300 km with 1000 dunes) across it in 1963 (it is now used 50 years later by tourists to cross the Simpson desert and named on the maps as the *French line*). With Dean Drayton and Rene Quin, we used reflection geophones to shoot from time to time long offsets in order to see the reflection events as refraction first events.
On the reflection profiles there are 3 events C (Cretaceous), P Permian and Z unconformity and on the following across a fault the correlation on reflection was unclear but with the long offset the correlation was clear the Permian present on the left was absent on the right.

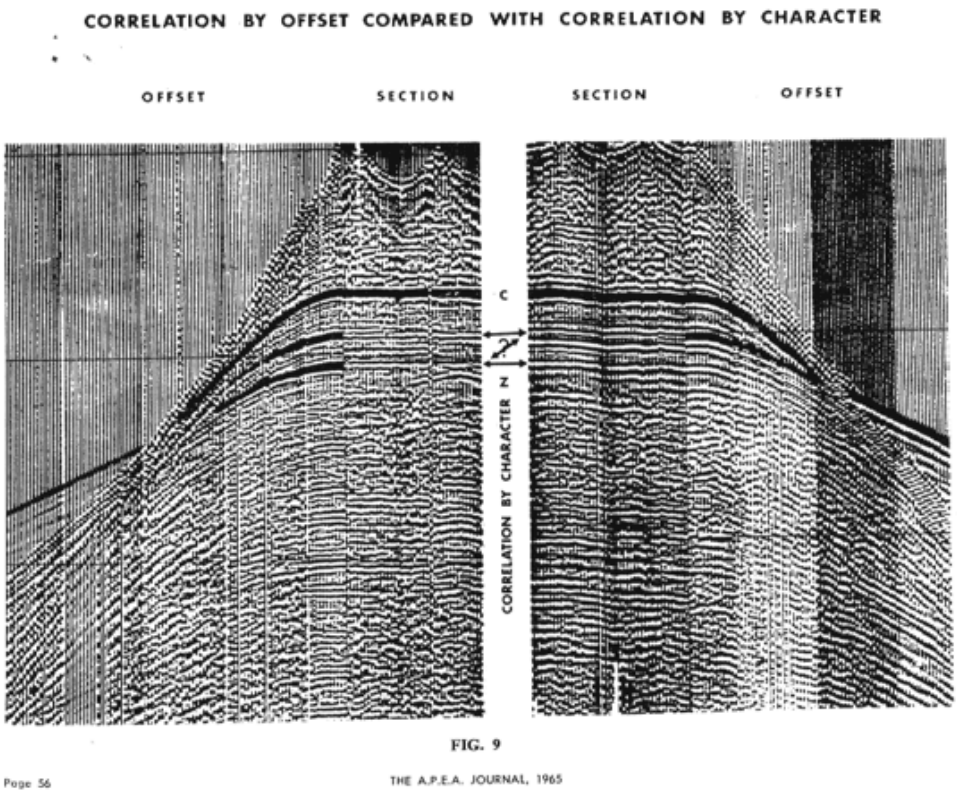


Figure 24: Simpson desert: two refraction shots across a fault from Laherrere & Drayton 1965

FPC Australia drilled two dry wells (Punri & Witcherie) on the Simpson desert and decided to relinquish the permits. Later about 20 wells were drilled in the Pedirka and Simpson basins and they all were dry.

Our exploration of the Simpson desert was a failure as finding oil, but was a success as finding quickly and cheaply that the oil potential of theses basins were very poor, thanks to refraction.

Conclusions

It is hard presently to find reliable documents on Hassi Messaoud water wells history. Present Wikipedia displays a fake well.

I hope that the September AAPG Explorer article will bring more information from Algerian geologists.

French exploration in the Sahara desert was a mixture of success and failures, but the two largest oil and gas fields (Hassi Messaoud and Hassi R'mel) in Africa were found in the first five years round of exploration

Without refraction Hassi Messaoud would have not been found in 1956 and the history of Algeria would have been different.

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