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**INTEGRATION OF A SURFACE GEOCHEMICAL SURVEY AND THE SEISMIC AND  
GEOLOGICAL DATA IN THE NORTHERN FLANK OF THE TINDOUF BASIN:  
IMPLICATIONS ON EXPLORATION RISK ASSESSMENT**

**N.Ibrihen**

Sonatrach Division Exploration, Bt.C, Avenue of November 1st, Boumerdés 3500, Algeria

The petroleum interest of the Tindouf basin is so veiled of shaded zones that there is difficulty proving with high certainty its prospectivity. The previous limited information tended to condemn its prospectivity

This paper deals with the integration of results of an older surface geochemical survey and the seismic and geological data in the Northern flank of the pericratonic Tindouf basin. It remains a very under-explored basin in the southwest of the Algerian Sahara. This Paleozoic basin is the only domain of the western Algerian Sahara to not have had seismic surveys since 1979 or drilling since 1971. However, the presence of source rocks, reservoirs, seals and either stratigraphic or structural traps are believed to exist.

It is important to underline that the two pericratonic Paleozoic Tindouf and Reggane basins are genetically related. They are situated in the eastern border of the West African Craton. Both display the same dissymmetrical transverse profile, and are characterized by strong burials having resulted in the buildup of a significant thickness of sedimentary cover. Jurassic dolerite intrusions are identified in both basins.

The surface geochemical prospecting clearly identified anomalously high surface occurrences of propane. Such anomalies could be linked to a migration of hydrocarbons into scattered accumulations. This is interpreted to indicate that important regional faults that split up the Northern flank of the Tindouf basin in various anticlinorium can be hydrocarbon migration paths.

There is a low content of non-saturated hydrocarbons and an abundance of paraffinic hydrocarbons by gas chromatography. This is very similar to the oils and/or condensate gas of the Sahara. In order to confirm this interpretation, measures of total carbon on raw rock and on washed rock, and chloroform extraction on powder, which showed weak contents in total organic carbon (TOC), what is little compatible with a potential source rock. A total lack of chloroform extract that attests to the absence of the heavy component of oil usually present either in formations having been or being sites of oil accumulations.

In the Tindouf basin, it has been assumed that the source rock is burnt. However it is comparable to the thermal regime of the Reggane basin, including magmatic (dolerites) episodes. The map of the heat flow of the Northwest of Africa shows an increase in values from west to east. Say, the heat flow of Tindouf basin is lower to the Reggane depression one, which is itself lower to the prone eastern Ahnet basin one. Apatite and Zircon fission track data (AFTA, ZFTA) show the geothermal paleogradients of Reggane basin were less than those of the eastern Ahnet basin. And it is the same picture for the present geothermal gradients. It is interpreted that the geothermal paleogradients of Tindouf basin were between those of Reggane and Ahnet depressions.

### Geochemical Modeling

Currently, Ordovician, Silurian and upper Devonian source rocks are in a very advanced maturity state (dry gas) from the standpoint of geochemical modeling. This modeling suggests that during all previous phases, mainly pre-Hercynian, the biggest volume of oil generated would have migrated outside of the Tindouf depression, if structuring is post-Carboniferous. However the phase of Hercynian generation these source rocks continued to generate some hydrocarbons (gas) in the Northern flank and in the center of the basin. These quantities probably migrated of the central zone of Tindouf basin toward borders.

Because of the hypothesis of late structural activity post dating after the time of generation and expulsion of hydrocarbons, the problem of timing has been compared with the tectonic history of the Wyoming-Utah basin. There it is proved favourable for the preservation of hydrocarbons within structures. It can be speculated that reactivation of the structures and therefore a likely destruction of the fluids by Mesozoic times occurred with orogenic movements of the Anti Atlas.

### Seismic information

Older well locations were positioned on surface structure that does not correspond to buried structure. Minimal hydrocarbon shows or weak flows were reported. Besides, the seismic data did not reflect the entire surface structures for lack of adequate seismic coverage of satisfactory quality.

### Well Data

The analysis of sparse well data (even though situated outside of structures) shows that tests were most often not technically successful.

### Source Rocks

Burned (cooked) source rocks related to important thermal regimes, the compact reservoirs consequent of a strong burial, hydrothermalism marked by the magmatic intrusion episodes, the juvenile structures, that are as many prejudices that made only dive further the Tindouf basin in the isolation of the point of view exploration.

### Conclusions

1. Surface geochemical data suggest the presence of live hydrocarbons.
2. Recent seismic surveys show discordance between exist in the basin surface and buried structures
3. Old test wells were drilled only on surface structures.
4. Comparison to an area of the United States suggests that late generation of structures didn't expulse all hydrocarbons outside of this basin.

Key Words : West African Craton, Geochemistry, Propane, Geothermics, Prospectivity