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### Producing Basins of Argentina: Reducing Risk through use of Surface Geochemical Exploration Techniques.

Many of the sedimentary basins of Argentina are characterized by trapping conditions that are especially well suited for investigation with surface geochemical exploration methods -- methods that can substantially reduce the exploration risks associated with trap integrity and hydrocarbon charge.

Detailed geochemical surveys and research studies have documented that hydrocarbon microseepage from petroleum accumulations is common and widespread, is predominantly vertical, and is dynamic. Because hydrocarbon microseepage is nearly vertical, the extent of an anomaly at the surface can approximate the productive limits of the reservoir at depth.

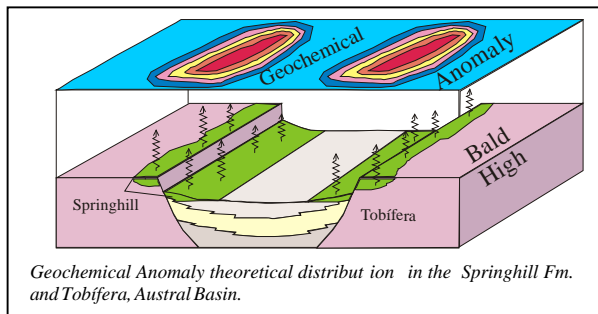
From the logistic point of view, favorable characteristics of Argentine basins include a semiarid climate with little vegetation and with minimal cultural contamination. This facilitates the field work and lowers the costs. This is an important advantage with respect to most of the other South American countries, where much of their area is dominated by dense vegetation (jungles) and access to the area is generally difficult. Additionally, a high percentage of Argentina's new prospects and developing fields have a strong stratigraphic trapping component and geochemical exploration methods are highly effective in locating stratigraphic traps.

Geochemical exploration surveys are conducted for the following purposes:

Prospect Generation and Prospect Evaluation: the objectives of these surveys are to (a) high-grade existing leads and prospects on the basis of probable hydrocarbon charge, (b) to determine probable hydrocarbon composition of the accumulation (oil, gas, condensate; thermogenic or biogenic); (c) aid in drilling site selection, (d) generate geochemical leads for geologic and seismic evaluation, (e) evaluate leases and concessions prior to renewal or relinquishment.

Field Development and Production: specific objectives of development surveys are (a) the early delineation of field limits, (b) identification of by-passed pay or undrained reservoir compartments, (c) evaluate infill or step out drilling locations, (d) documentation of hydrocarbon drainage over time using repeat geochemical surveys, and (e) to monitor waterflood or CO<sub>2</sub>-flood operations.

### Austral Basin

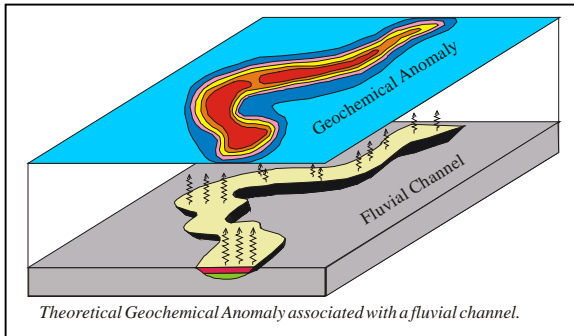


The traps known so far occur in the Springhill, Magallanes and Tobifera Formations. Stratigraphic component in trapping is very important, but such traps are not always easily imaged or mapped seismically. Consequently, there are cases where the reservoir

limit is not clearly defined. Surface geochemical surveys can help to identify the limit of the reservoir by using gridded surveys to establish the shape and extent of the geochemical anomaly at the surface. Also, through the use of geochemical fingerprint techniques it is sometimes possible to identify the reservoir formation responsible for the geochemical anomaly.

In the Austral Basin, the continental and marine sandstones of the Springhill Formation form pinch-outs against the basement, while the deltaic Magallanes sandstones form stratigraphic traps associated with favorable paleogeographic positions.

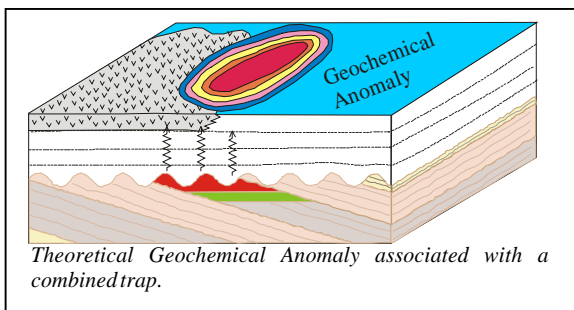
### San Jorge Basin



Traps in the San Jorge Basin generally have a strong stratigraphic component due to the lenticular nature of the fluvial sandstones, and an important diagenetic component that generates lateral variations in permeability. Surface geochemical surveys can define the active faults and other hydrocarbon migration pathways, the distribution of

lenticular fluvial reservoirs, and the stratigraphically older potential reservoirs that may have been deposited in half-grabens.

### Neuquen Basin



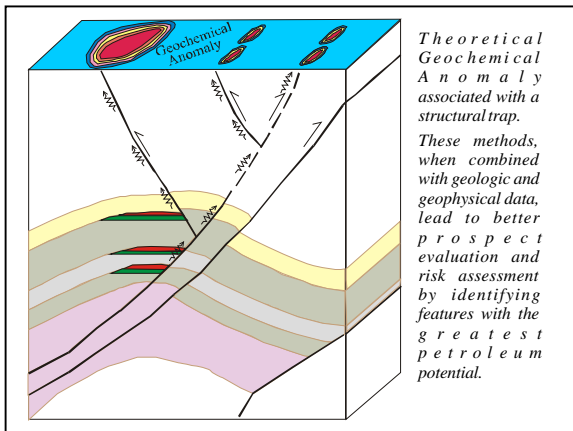
More than half the discovered traps in the Neuquen Basin are stratigraphic or include a strong stratigraphic and/or diagenetic component. The effectiveness of traditional geologic and seismic methods for discovering such subtle traps is limited. Surface geochemical exploration techniques can more reliably identify these traps. Furthermore, these

methods can help to identify the reservoir limits, the presence of lateral changes of permeability and other reservoir heterogeneities that influence in the distribution of the reservoir fluids. Additionally, volcanic deposits cover large areas in this basin with basaltic lavas that make exploration, especially seismic surveys, very difficult and costly. In these cases surface geochemical exploration is a clear alternative because the presence of basalts at the surface does not limit hydrocarbon microseepage and the formation of surface geochemical anomalies.

### Cuyo Basin

The Cuyo Basin is of continental origin and its main reservoirs (Potrerillos, Rio Blanco and Barrancas Formations) display strong lateral variations in facies and permeability. A significant volume of the oil and gas present in these basins is reservoir in subtle stratigraphic traps, combination traps, or diagenetic traps – all difficult to recognize with traditional seismic methods. More importantly, seismic data in these geologic settings yield little or no information about whether the trap is charged with hydrocarbons.

## Northwest Basin



The Northwest basin presents two geotectonic environments well defined, the fold belt and the foreland. The traps in the Carboniferous fluvial sandstones are often difficult to identify seismically because of their stratigraphic nature. Surface geochemical surveys can help to discriminate between charged and uncharged reservoirs in different structures and to identify more prospective areas associated with fluvial stratigraphic traps. In this geologic setting, like in the previous ones, the

presence of a positive geochemical anomaly provides strong evidence for the presence of a petroleum accumulation, and thereby greatly reduces the exploration risk.

Results of recent microbial and soil gas surveys in these Argentine basins will be presented which will document the value of hydrocarbon microseepage surveys for high-grading exploration leads and prospects. Such geochemical data, when properly integrated with geologic and seismic data can focus the exploration effort on those areas with the greatest remaining hydrocarbon potential.