

PS Geochemical Anomalies Characterization by Microbial and Trace Elements Analysis Related to Hydrocarbon Migration, Neuquén Basin, Argentina*

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Abstract

Organotroph bacterial accumulation and trace elements present in soils and sediments are good indicators for active oil reservoirs, due to microseepages of light hydrocarbon gases and other geogases that reach the surface through pore spaces or fracture systems at both local and crustal scales. Trace elements like V, Cr, Ni, Co, among others, are also carried upwards in the shape of microbubbles by means of diffusion and effusion.

In an area of northern Neuquén Basin, a geochemical exploration survey took place, based on transects with sampling points of 400 meters distance from one another. Transects were perpendicular to the structures present in the area. Geological formations were taken into account when sampling the soil surface, identifying traits like texture, development and origin. Satellite Image processing with NDVI and Tasseled Cap algorithms were used to discriminate plant photosynthetic efficiency and soil moisture. Soil samples for microbial analysis were taken at 40 cm depth and placed in sterilized jars. Using a modified MPOG method, edaphic bacterial colonies were counted in UCF/g. Also samples were taken from the same depth to make the trace element analysis.

The results turned to be positive and made possible to identify two types of geochemical anomalies:

- a) those belonging from reservoirs and having background levels induced by mature source rock and,
- b) mostly derived from reservoirs and minimal background values (immature source rock).

Trace elements like V led to verify the hypotheses of uplifting pushed by microbubbles of carrier gases, because of the known high V content of the oil and its high values close related to bacterial anomalies.

This element was present both with bacterial anomalies (active microseepage) or without bacterial activity (ancient and inactive microseepage). Trace elements and microbial analysis both showed high correlation over the faulting zone and led to discriminate sharply between reservoir derived anomalies from reservoir and source rock derived anomalies.

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Trace elements were analyzed with a handheld X Ray Fluorescence Niton XL3t 500 equipment. Chemical elements like V led to verify the hypotheses of uplifting pushed by microbubbles of carrier gases, because of the known high V content of the oil and its high values close related to bacterial anomalies. This element was present both with bacterial anomalies (active microseepage) or without bacterial activity (ancient and inactive microseepage).

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References

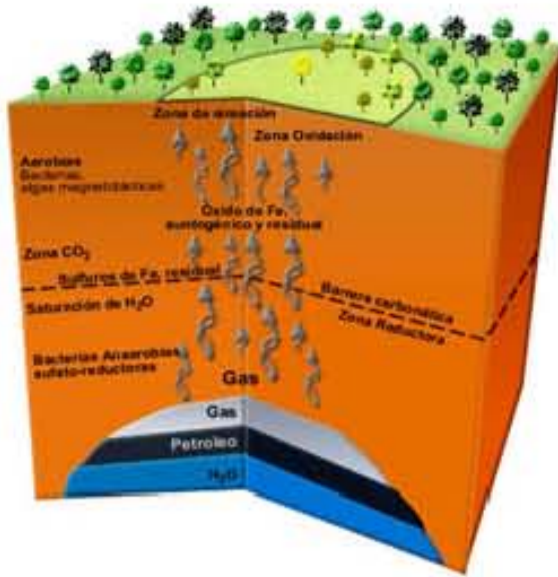
Larriestra F., de Los Reyes L. M., Chebli P., y Battista J., 2009. Análisis de Comunidades Vegetales y su vinculación con Anomalías Superficiales asociadas a Migraciones de Hidrocarburos, Cuenca del Golfo San Jorge, Chubut, Argentina. V Congreso Latinoamericano de Sedimentología y I Congreso Venezolano de Geocientíficos del Petróleo 2009, Puerto La Cruz, Venezuela.

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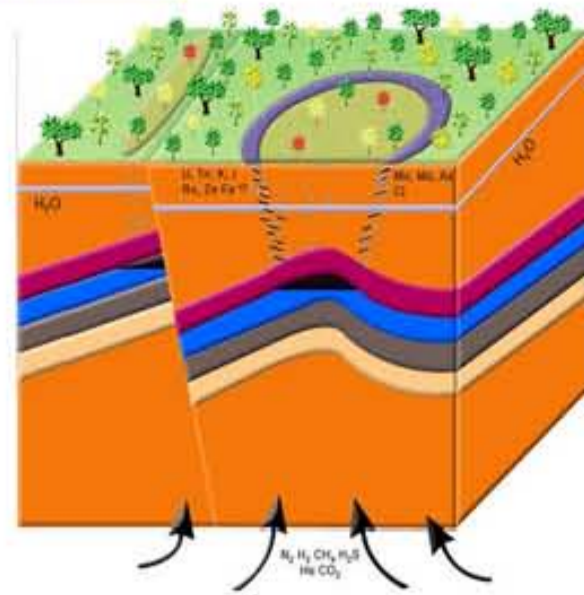
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Applied Models



Organic Geochemical Model

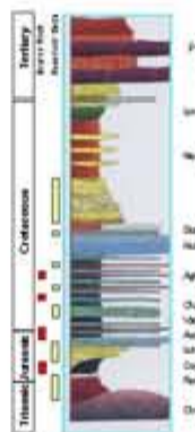
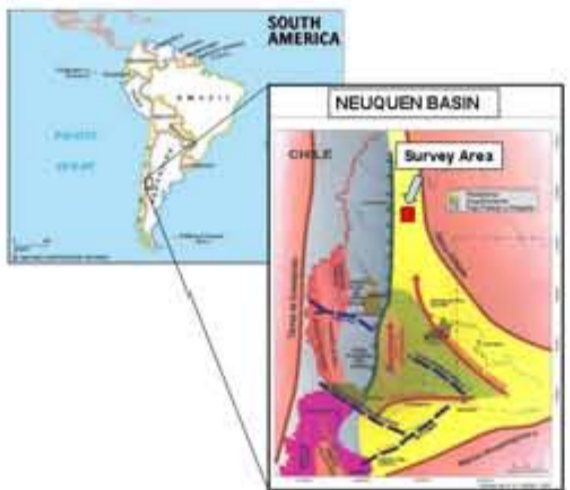
Reservoir hydrocarbon gases rise up through the stratigraphic column creating a reduction chimney (grey arrows) that reaches the surface. This creates an anomalous zone with high soil pH values that has an impact on plant community structure and diversity.



Inorganic Geochemical Model

showing the carrier gases (H₂, N₂, CH₄, He, CO₂, H₂S) raising from the mantle and carrying elements related to reservoir rocks. This phenomenon creates an anomalous superficial deposit of characteristic elements and minerals that influences the local ecosystem

Geological Setting

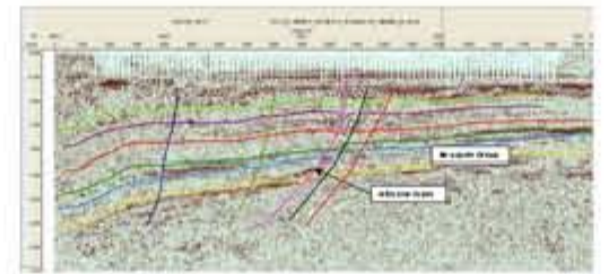


PETROLEUM SYSTEM

Source Rock
Jurassic Vaca Muerta Fm. is the main oil and gas source rock in the Neuquén Basin. Another is Cretaceous Agrio Fm. with less hydrocarbon generation potential, but its presence is important in this basin zone.

Reservoir Rocks
The reservoirs expected in this area are naturally fractured igneous and limestone rocks and clastics beds. The first type of reservoir are the main component of the Chachao Fm and Member La Tosca belonging to Huilín Fm. Clastics beds are common in border basin facies related to Neuquén Group and Loncoche Fm.

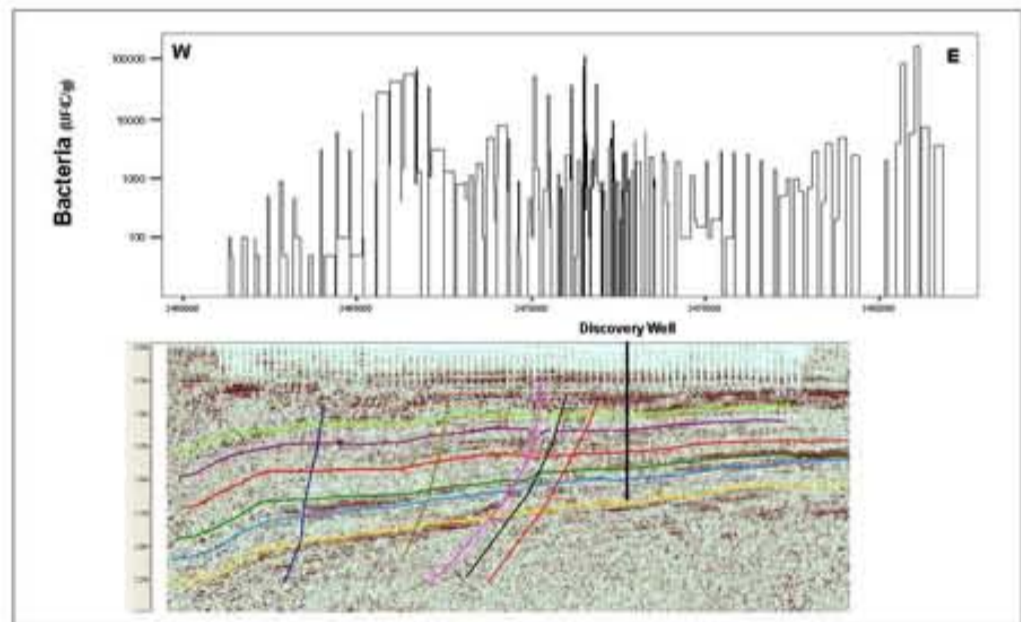
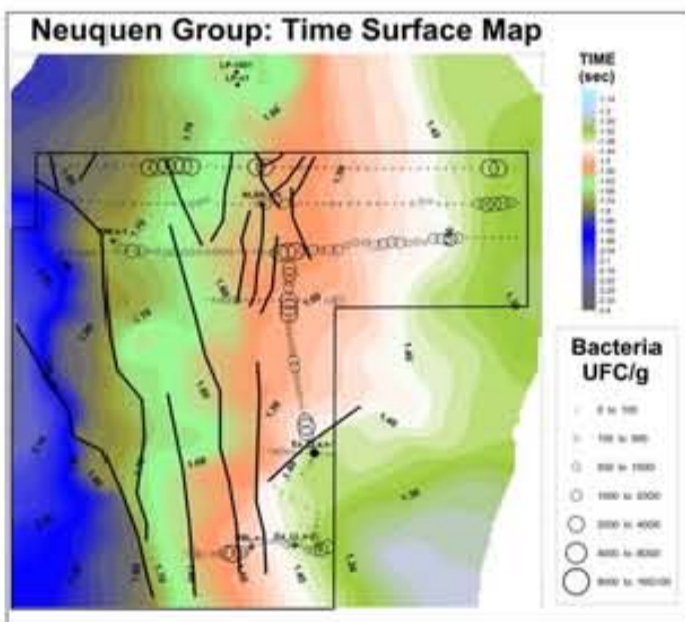
Seals
The seal are the evaporitic members of Huilín and Rayoso formations and shale levels interbedded in the Grupo Neuquén and Malargüe Fm.



OIL Trace Elements from Discovery well

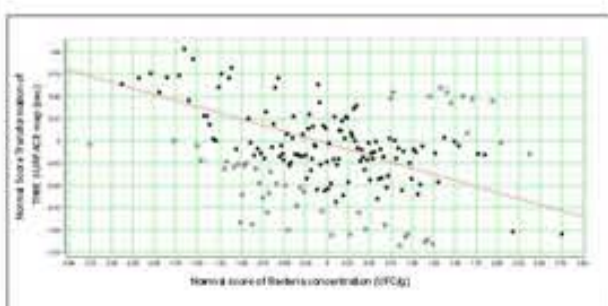
FRX	Mo	Zr	Ni	Fe	V	K	S
resgato 1	23.16	13.21	50.33	103.5	482.8	967.00	26088
resgato 2	23.62	14.66	71.08	114.6	499.1	1084.44	25132

RESULTS: Bacteria Concentration Trend

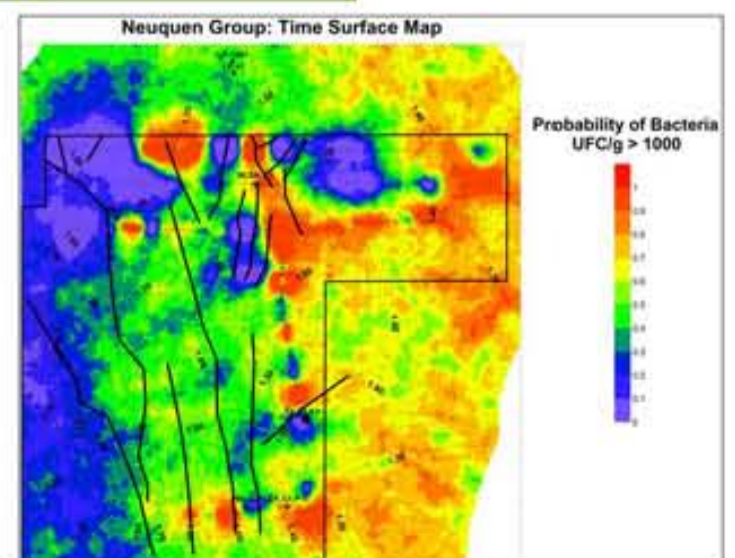
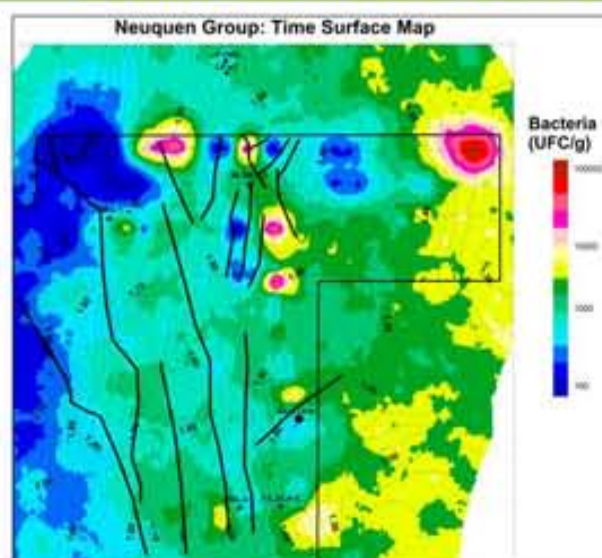


Seismic-Bacteria geostatistical integration

Secuencial Gaussian Simulation



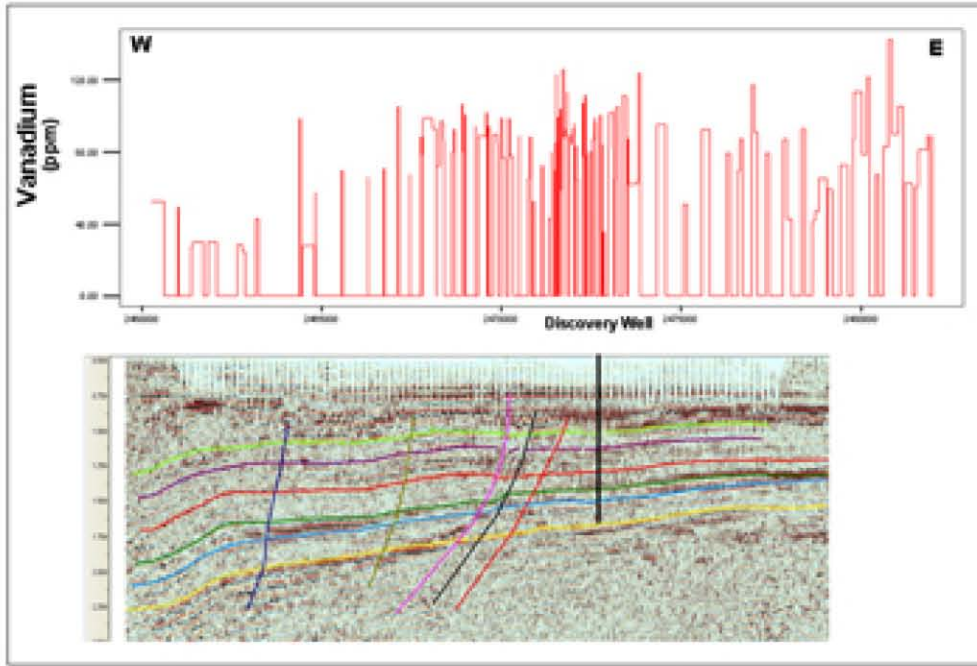
Secuencial Gaussian Simulation



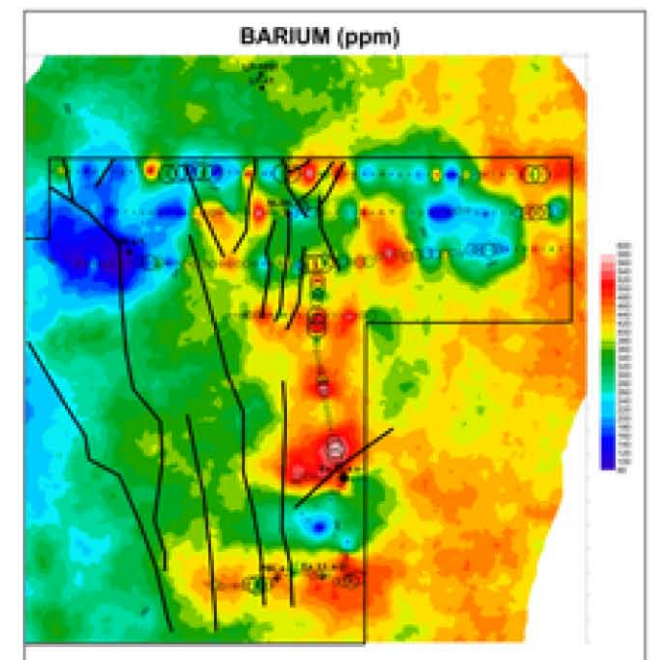
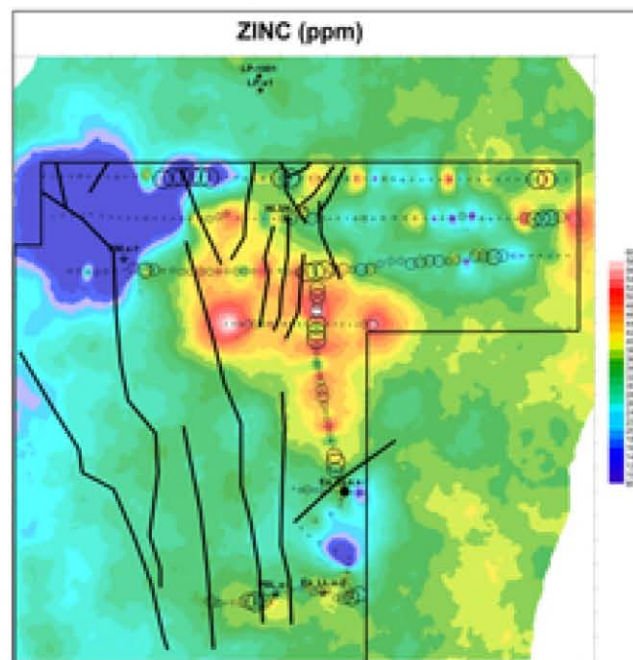
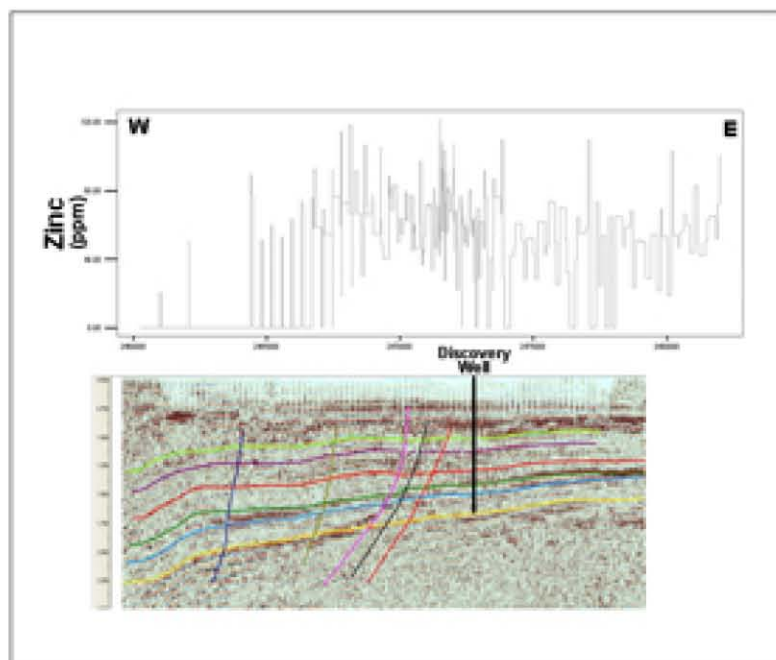
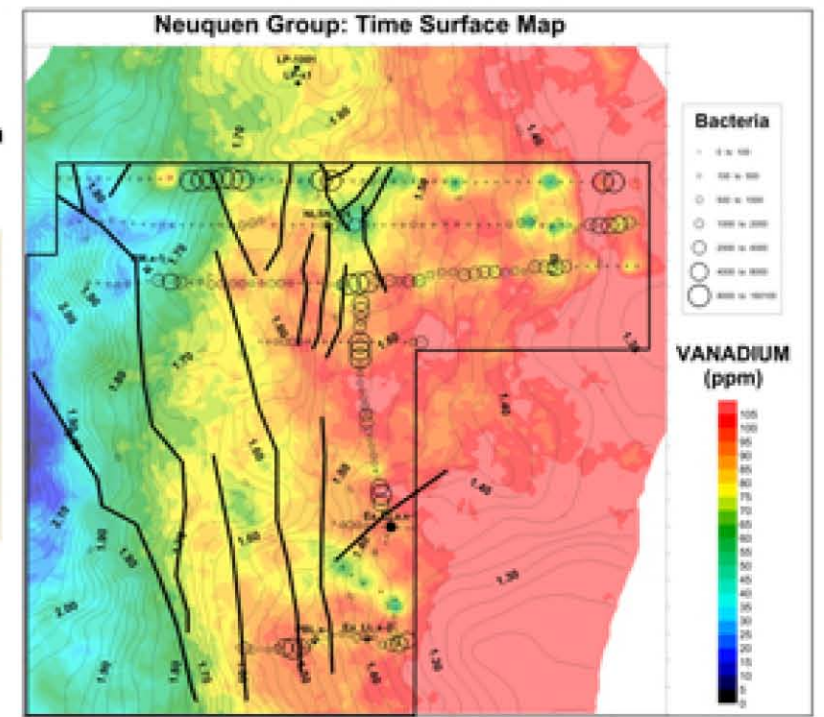
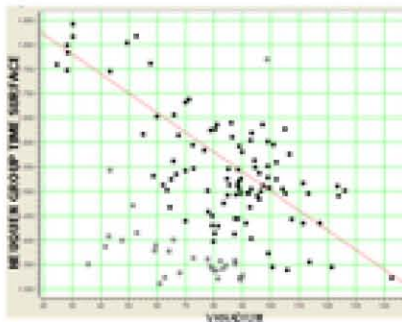
Seismic-Trace Elements geostatistical integration

Secuencial Gaussian Simulation

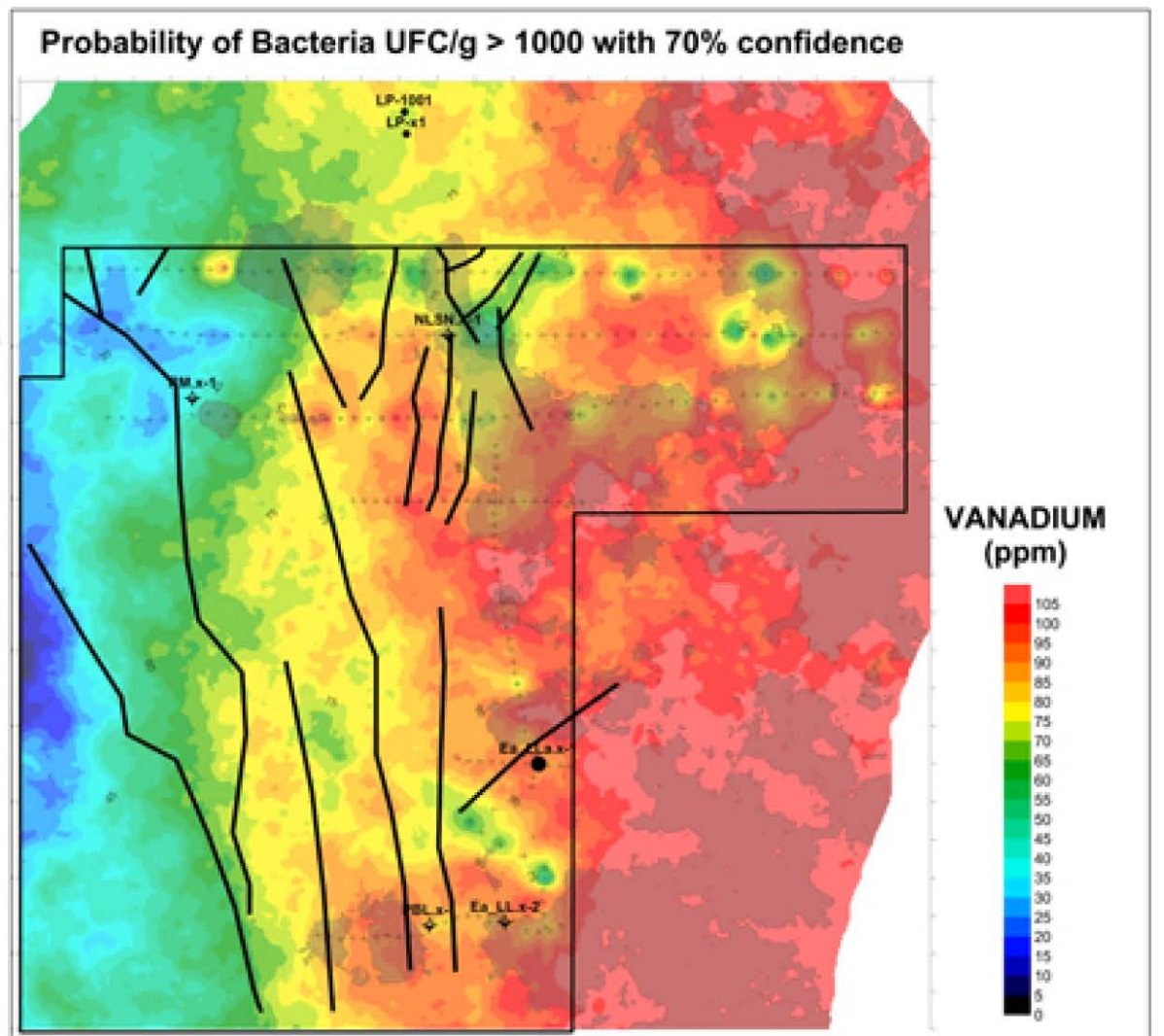
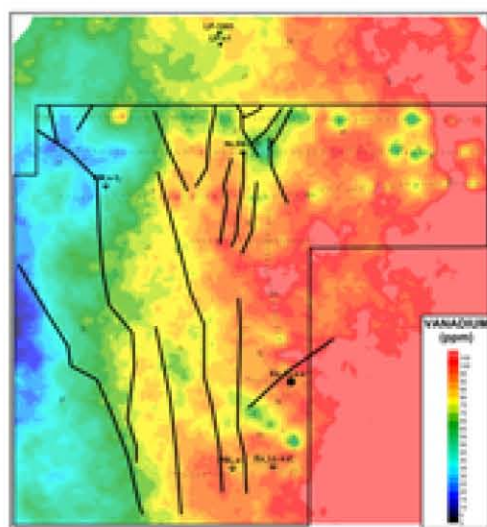
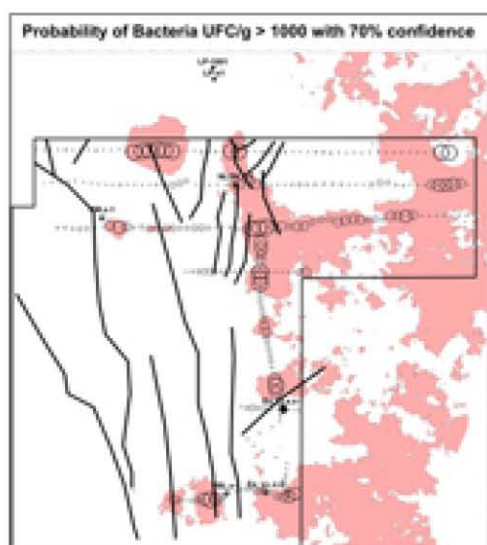
VANADIUM



Secuencial Gaussian Simulation



Conclusions: Active anomalies and Paleo anomalies discrimination



The study area is located nearby of the Llanquanelo lake (65,000 ha 35°45'S 069°08'W) Mendoza, Argentina.

Llanquanelo lake is a Natural Province Reserve since 1980. In 1995 was declared a Ramsar Convention Site.

Final Remarks

