Natural gas geochemistry and reservoiring of Xujiahe formation in central Sichuan Basin, China

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Based on analysis of structure evolution, hydrocarbon generation, reservoir condition and their relations in spacing and geological time, the geochemistry and reservoiring mechanisms of gases in Xujiahe formation were studied in Sichuan Basin. The formation is buried under 2000~3000m, and the basement of central area is rigid. It was up and down in the late Triassic when it was entirely depressed [1]. At transgressive stage, the first, third and fifth members widely developed coal related source rocks with the thickness of 120~250m, maturity of 0.8~1.3%Ro, and gases dispelled intensity was 10×10^8~$30\times10^8 m^3/km^2$. At regressive stage, the second, forth and sixth members developed three fluvial delta sedimentary sandbody. These contributed to a good play distributed larger than $10\times10^4 km^2$ just like a 'sandwich'. In gas reservoir, CH_4 accounts for 83.32%~94.31%, and C_2H_6 is 3.40%~12.93%, CO_2 is 0.04%~5.65%; $\delta^{13}C_1$ is distributed in -37.70‰~-27.79‰, $\delta^{13}C_2$ is -29.90‰~-25.00‰, $\delta^{13}Cco_2$ is -7.60~-12.25‰. The composition and carbon isotopes indicate the gases are coally derived with low maturity [2]. Whereas, gases in inclusions of the reservoir, CH_4 is 76.62%~97.79%, C_2H_6 is 2.35%~12.86%, $\delta^{13}C_1$ is -44.59‰~-39.31‰, $\delta^{13}C_2$ is -28.05‰~-25.31‰, and $\delta^{13}Cco_2$ is -8.56‰~-13.86‰. The gas composition and carbon isotope of gases in inclusion are wetter and more negative than in reservoirs, respectively. The mathematic modeling of reservioring of the gases in Xujiahe formation indicate that the reservoir have undergone three continuous stages. That is, minor charged in early stage (160~100Ma), largely in the middle when it deeply buried (100~65Ma), and redistributed in the late when it uplifted (65~0Ma). The structure in central Sichuan Basin is flat (the gradient is less than 3°), and the single gas reservoir is thin less than 10m and tight (the porosity is in 3~7%). The accumulation and resources of gases were lower ($<2.5\times10^8 m^3/km^2$) and buoyancy were restricted and obivous non-darcy percolation when gases accumulation. Water and gases immingled together and gas saturation different largely (10%~60%).

[1] Tao (2003) *Acta Petrologica Sinica* **19**(2), 327-336. [2] Dai (2004) *Organic Geochemistry* **35**(4), 405–411.

Impact of historical mining activities on soils and lacustrine sediments in Oruro, Bolivian Altiplano

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Oruro Department exhibits numerous polymetallic deposits which have allowed the development of mining activities. Both, artisanal and industrial mining, have resulted in substantial pollution of the soil and lacustrine compartments, thus making this particular region one of the most polluted areas in the Bolivian Altiplano.

The aim of this study was to establish the geochemical background of the zone and compare it with soils and sediments composition by means of a base data analysis and the characterization of lacustrine sedimentary cores (Uru Uru lake and Cala Cala lagoon). Uru Uru is a shallow and highly polluted lake [1] located in the Altiplano (~3700 m. a. s. l), whereas Cala Cala is an artificial lagoon located in the Eastern Andes Range (~3900 m. a. s. l.). To perform the study a compilation of soils and sediments base data was completed [1] [2], two coring campaigns were performed, and concentrations of the interest elements in sediments were determined.

The base data spatialitation (GIS) and geochemical results demonstrated the following: (a) As, Sb, Pb and Cd were mainly concentrated in surficial soils; Cd was mostly related to the Eastern Andes Range; Sb and Pb to the Vinto Foundry; and sediments from the Uru Uru lake exhibited important Cu and Zn concentrations. (b) Enrichment factors showed that Uru Uru lake sediments were enriched in As, Sb, Ag and Cd (56, 42, 10 and 9 and times respectively) in relation to the Upper Continental Crust. As concentrations were probably of natural origin; but Sb, Cd and Ag enrichment may have been related to mining activities in the zone. (c) The correlation matrix illustrated that variations in Cd, Zn and Cu concentrations are related on a global scale.

The results of this work will allow the discrimination of different sources of heavy metals in soils and sediments, and will be the base of (1) an exhaustive study of pollution historic register in the Uru Uru lake and (2) in the role of redox processes in post-depositional redistribution of heavy metals.

[1] PPO 9612–1996. Impacto de la Minería y el Procesamiento de Minerales en Cursos de Aguas y Lagos. 120 pp [2] PPO 9608–1996. Plan Final de Gestión Ambiental. 64 pp.