Sr isotopic composition in Variscan granitoids, Silurian metasediments and waters from the Boticas area (Northern Portugal)

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The processes of water-rock interaction controlling the Sr isotopic composition of superficial and groundwaters from the Boticas sanitary landfill and from the Carvalhelhos mineral waters are investigated in this work. The Boticas region is composed of several intrusions of Variscan granitoids emplaced into Silurian metasediments. The granitoids, consisting of quartz, K-feldspar, plagioclase (albite - oligoclase) and micas show Sr content, and present-day $^{87}Sr/^{86}Sr$ isotopic ratios varying between 37-105 ppm and 0.749238-0.886953, respectively. In the Silurian metasediments, quartz and mica are modally important mineral phases and plagioclase is absent. Their Sr contents range from 41-60 ppm and their $^{87}Sr/^{86}Sr$ ratios from 0.760103-0.782684. The surface and groundwaters from the Boticas sanitary landfill have bicarbonate compositions with relatively high calcium and magnesium contents (mixed-type), whilst the Carvalhelhos mineral waters show sodium bicarbonate compositions. The range of Sr and $^{87}Sr/^{86}Sr$ values in the Boticas waters (Sr = 0.0042-0.056 ppm; $^{87}Sr/^{86}Sr$ = 0.718106-0.732276) is much wider than those of the Carvalhelhos mineral waters (Sr = 0.072-0.076 ppm; $^{87}Sr/^{86}Sr$ = 0.726255-0.726322). The observed differences appear to be controlled by two major factors: (a) lithological variations of the bedrock (granites/ metasediments in the Boticas landfill and essentially granitic in Carvalhelhos) and (b) residence time. All the analysed waters show $^{87}Sr/^{86}Sr$ isotopic ratios higher than those of the rainwater (Sr poor and non-radiogenic; $^{87}Sr/^{86}Sr$ = 0.710040 - 0.715645). It is therefore likely that the Sr isotopic signatures of the analysed waters reflect variable degrees of interaction between rainwater and the radiogenic bedrock. The superficial waters with less residence time tend to show the lowest $^{87}Sr/^{86}Sr$ isotopic ratios, whilst the groundwaters are generally more radiogenic. In both the Boticas and the Carvalhelhos groundwaters, hydrolysis reactions involving the plagioclase from the granites appear to be the major mechanism of water-rock interaction. The absence of plagioclase in the Silurian metasediments suggests that the Variscan granitoids have a significant influence in the Sr-isotopic composition of the waters of the region, although the potential participation of biotite hydrolysis reactions cannot be ruled out in the case of the Boticas groundwaters.

Adsorbed soil gas and microbial studies for Hydrocarbon prospecting: Jamnagar sub-basin, Gujarat, India

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This study was designed to combine and compare Adsorbed gas (acid released gas) and Microbial methods with sub-surface geology. These techniques provides to understand the hydrocarbon generation, migration and accumulation processes within a basin prior to drilling. Sub -surface soil sample were collected on a detailed grid over the Jamnagar sub-basin, India. The area is largely covered and prominently exposed by the Deccan Trap (basaltic rocks), whose thickness varies from few hundreds to thousands of meters. Traps are underlain by thick Mesozoic sediments (100- 4000 m), which can form potential source rock for hydrocarbon. Deccan Trap volcanicity during Late Cretaceous may have generated the requisite thermal conditions and acted as a catalyst in Mesozoic hydrocarbon-generation process. Sedimentation in marine intertonguing environments is considered to have been favorable phenomena for hydrocarbon generation and entrapment (Kumar *et al*., 2004).

Adsorbed soil gas of light hydrocarbons (C_1 to C_5) shows variotions in concentrations of Jamnagr sub-basin. The C_1, ΣC_{2+} and C_3 concentration range from 3-518 ppb, 0-977 ppb and 0 – 331 ppb, respectively. Corelation factor is more than 0.9 between C_1 - C_2, C_1 - C_3, C_2 - C_3 and C_1 - ΣC_{2+}, which indicates that light hydrocarbon components are generated from a thermogenic source. The compostional ratio of C_3/C_1 $G10^3$ shows that majority of samples fall in oil zone (Jones&Drodz, 1983). The propane Oxidizing Bacteria counts varies from 60 – 68600 CFU/gm. Adsorbed soil gas and microbes intensities indicate that this is warm area for hydrocarbon. The adsorbed soil gas data and microbial population are concordant and coincide with major structural features in basin. This study clearly demonstrates that adsorbed soil gas and microbial methods with geology can be applied sucessfully to demarcate the hydrocarbon reservoir zone for future exploration.

References

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