Brines and saline fracture waters in the terrestrial subsurface: A niche for the deep biosphere and unique analog for Mars

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Saline waters and brines have been widely observed in deep fractures in the Precambrian igneous rocks of the Canadian Shield and South Africa. Recent molecular studies indicate that these deep brine waters contain low-abundance, low-diversity microbial ecosystems [1, 2] distinct from those found in the shallower, less saline fracture waters. This discovery has significantly expanded our understanding of life in the deep anaeorobic terrestrial environment and provided an important analog for studies of early life on Earth and for the search for life on Mars.

To understand the dependence of microbial ecosystems on water chemistry, we studied the brine waters from Timmins (Ontario), and Thompson (Manitoba) in the Canadian Shield. The fracture brine waters are dominant by Ca, Na, Cl with salinities of 150-290 g.TDS/L. Na-Cl-Br relationships exclude the possiblilty of brine sourced by freezing seawater during the Pleistocene glaciation as had been recently suggested [3]. The geochemistry of Na-Cl-Br favors a source related to evaporated seawater which may originate from the mid-Devonian or even earlier [4]. Oxygen and hydrogen isotope compositions of these brine waters lie well above the global meteoric water line, indicating significant oxygen and hydrogen isotope modification by fluid-rock interaction. Noble gas studies indicate 100s Ma to possibly Ga gas components in the fractures, suggesting little or no disturbance of these fractures over geological time scales and bulk water residence times on the order of millions of years – again supporting an a geologically ancient origin for these fluids.

Based on above observations, we propose that the fracture saline waters and brines in the deep terrestrial subsurface provide the best opportunity to host microbial ecosystems that have been separated from those on the surface for millions of years and sustained on the limited energy and nutrient sources produced by fluid-rock interaction. They demonstrate the potential for life to sustain its activity over geologic time in ancient low temperature tectonically quiescent rock fractures that serve as an important analog for the Martian subsurface.

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Research on the Basin Formation and the Eruption of volcano During Carboniferous period in front of the Kelamli Mountain in Junger Basin

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Experiments and results

Junger Basin was located among the intersection of Kazakhstan, Tarim and Siberia plates during Palaeozoic. The research on the basin formation and the volcanos during this period were never stopped because of the complicated structural settings and great breakthough of gas exploration has gained in Carboniferous volcanos.

12 Volcanic rocks samples dating by SHRIMP and LA-ICPMS and elemental analysis, palynologic analysis were conducted in this essay. The results were follows. There were different eruption structural settings of volcano during carboniferous period in front of Kelamli Mountain. The duration of early stage was about from 354Ma to 330Ma. The range of dating detection is 350Ma~ 335Ma.Volcanos were arc. The samples points are in the arc areas in the figure of logτ-logσ. Elements Nb, Ta, Ti are parrent deficit and element Sr is abnormal in the figure of the distribution of elements cobweb. All of above were interrelation with the lagoon or tide of sedementary environment in this period. The duration of late stage was about from 320Ma to 295Ma. Volcanos were intraplate. The sample points are in the intraplate areas in the figure of logτ-logσ such as typical sample DX17. Elements Nb, Ta, Ti are little deficit and element Pb is abnormal in the figure of the distribution of elements cobweb. All of the above were interrelation with the occurrence of considerable granite aging from 314 Ma to 295Ma in the mountain around the basin in the same period. This indicates that geological setting was extended. During the period between 330Ma and 320Ma, volcanic activity stopped and a set of sedmentary rock deposited.

The evolution of the carboneferous system as follows. The early volcanic eruption stage indicated that Junger basin and its near areas were in a concourse geological setting. Kelamli Ocean began to dive and a lage scale of volcanos erupted during this period. During the 330Ma to 320Ma, Kelamli Ocean had dived into the plate of Yemaquan and had been died out since then. Accompany with this, a depression was formed in front of the mountain. During the late of the carboneferous, with the gelogical setting changing from concourse to extend, another large-scale of volcanic activity occurred again.

Conclusions

There were 3 evolution stages during carbonferous. From early to late stage, there were coexisting volcanos and sedments, maily sedments and volcanos respctively. In a all, there formed two sets of source rocks and two sets of reservoirs during carboniferous period.