Isotopic indicators of epigenetic alteration of Upper Proterozoic sediments on Siberian Platform

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Introduction

Isotopic data give the principal possibilities to obtain information on the evolution of the terrestrial exogenic system. Two main difficulties prevent the obtaining of reliable data: secondary rock alteration and poor knowledge of the true deposition age of sediments. In the first place it can be applied to Precambrian time. That is why it is so important to study well-documented successions. The Siberian platform is potentially one of the most suitable grounds of this type; though we have discovered difficulties here also. However, new interesting aspects of the problem have appeared by the study.

Objects and methods

By this time data on two regions of Siberia have been obtained. One of them is typical section of Upper Proterozoic succession from SW slope of Anabar Shield along Kotuykan River. The other is situated nearly 1000 km southwards, in vicinity of Vanavara settlement.

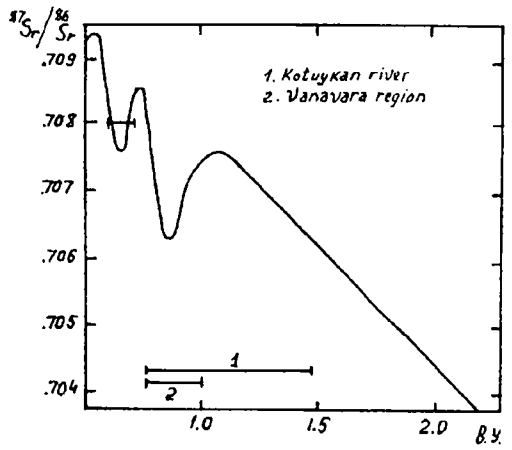

FIG. 1. $^{87}Sr/^{86}Sr$ of Upper Proterozoic sediments of Siberia. Seawater curve compiled from Derry et al., 1992; Asmeron et al., 1991; Derry and Jackobsen, 1988; Veizer et al., 1983; Veizer and Compston, 1976.

Carbonates and anhydrites were leached in 2N HCl. Silicate samples were treated by standard techniques. $^{87}Sr/^{86}Sr$, Rb, and Sr concentrations were measured by isotope dilution technique using MAT-260 mass spectrometer. Uncertainties (2σ) were 0.00005 for $^{87}Sr/^{86}Sr$ ratios, 1% (silicates) and 2–3% (carbonates) for $^{87}Rb/^{86}Sr$ ratios. Stable isotope measurements were performed using MI-1201V MS with reproducibility to 0.1 for $\delta^{13}C$ and 0.2 per mil for $\delta^{18}O$ and $\delta^{34}S$ values.

Geological setting

The unmetamorphosed Upper Proterozoic succession on SW slope of Anabar Shield is composed of three groups. The basal one consists of about 650 m thick sandstones, with minor carbonates in the roof of the group. Biostratigraphical age of this group is Low Riphean. The upper group of Riphean consists entirely of about 1000 m thick dolomites. The overlying Vendian group is marked by hiatus and disconformity; it consists of about 200 m carbonates.

The Vanavara succession was sampled in cores of oil prospecting drills. Riphean sediments of lower, Ognjevskaja groups are sand- and silt stones and interbedded dolomites. The overlying Kamovskaja group consists of two units. The lower 700 m is composed of dolomites and interbedded anhydrites; the upper 400 m is pelitic rocks with sparse dolomites. Vendian sediments disconformably overlay this unit. The lower 60m are sandstones, the upper 300 m are interbedded dolomite and anhydrite. They are overlaid by salt of Cambrian age.

Dolomites and anhydrites were sampled in two regions to estimate the influence of radiogenic Sr from clastic units on chemical sediments, and to evaluate $^{87}Sr/^{86}Sr$ for Upper Proterozoic seawater. Glauconites and siltstones from Ognevskaja unit were also sampled in Vanavara region to estimate the age of the strata.

Results and discussion.

$\delta^{18}O$ and $\delta^{13}C$ remain relatively invariant in all thickness of studied rocks. Only Vendian strata show distinct negative $\delta^{13}C$ anomaly up to –4 on

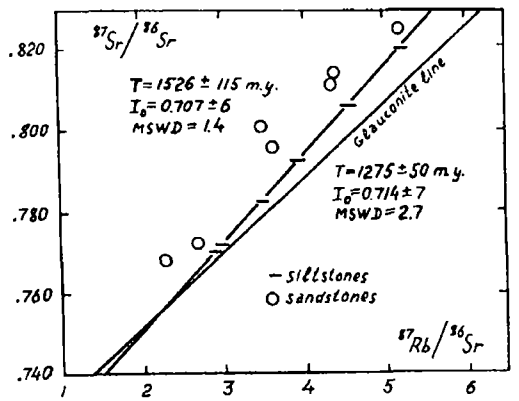

FIG. 2. Rb-Sr isochron for siltstones; glauconite isochron is shown as reference line.

Kotuykan and –8 per mil on Vanavara. On Kotuykan the $^{87}Sr/^{86}Sr$ becomes progressively more radiogenic with coming to lower section of clastic rocks. This effect is more expressive on Vanavara, where the lowest $^{87}Sr/^{86}Sr$ is in the middle of the thick sequence of Upper Riphean carbonates and anhydrites. The most unlooked-for result is the very low $^{87}Sr/^{86}Sr$ ratios for deposits of such age. They markedly do not agree with the seawater curve (Fig.1). It should mean, the stratigraphic age of the sequence is wrong. The same conclusion is evident from Rb-Sr age determination (Fig.2). Thin section studies show that the pelitic rocks isochrone can be explained as a time of secondary potassium feldspar origin. So, the deposition age of these rocks should be more ancient, than 1.5 b.y. If it is true, serious revision should be done on some stratigraphic problems.