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Isotopic composition of carbonates from Precambrian apatite-carbonate rocks

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Apatite deposits are found in carbonate and carbonate-silicate rocks which are widespread in metamorphic complexes of the Precambrian areas (Aldan Shield , Peri-Baikal region, North Chinese Platform, Ukrainian Shield, etc.). The rocks comprise a number of morphogenetic types, including primary sedimentary (stratiform and lenticular bodies) and various later rocks (younger carbonate veins and pockets), whose geneses are related to metamorphic and metasomatic processes. The stratiform and lenticular carbonate rocks can be classified into the following groups according to their mineral assemblages: (a) marbles (>95% carbonates), (b) calc-silicate rocks (10 - 75% silicates), and (c) apatite--carbonate rocks (ores).

There are now extensive materials on the isotopic compositions of carbonates from metamorphic and metasomatic rocks. It was established that an increase in the grades of metamorphic and metasomatic alterations is associated with the enrichment of carbonates in light carbon and oxygen isotopes, and the most significant shifts in C and O isotopes from those of the initial sedimentary rocks result in values similar to those typical of skarns and carbonatites. This opens the possibilities of using isotopic data to assay the extent of transformations of the primary rocks.

The isotopic composition of carbon and oxygen was determined in samples of carbonates from rocks of all morphogenetic types of the Aldan and Ukrainian Shields , Peri-Baikal region, North Chinese Platform, etc. Results of carbon and oxygen isotope work performed on different deposits confirm that each of these deposits represents a clearly defined and isotopically distinct sedimentary facies. The values of C and O isotopes for the marbles, calc-silicate rocks, and apatite--carbonate rocks reflect their primary values and

are close to those in sedimentary Precambrian carbonate rocks elsewhere. Among the rocks examined, the highest C and O isotopes values were obtained for the apatite-carbonate rocks, whose protolith was produced chemogenically, most probably in shallow evaporitic basins, in a significantly reducing environment, at a limited influx of terrigenous material. The subsequent transformations of the primary rocks by meteoric waters and metasomatic fluids can be identified using low values of O and C isotopes.

The amount of apatite in the protolith was determined by the phosphorus concentration in solutions of the primary sedimentation basins and the fractions of clastic apatite, which was produced by intraformation erosion and weathering of nearby apatite-bearing rocks.