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RESULTS OF AN ESR-STUDY OF QUARTZ FROM THE ARCHAEAN METAMORPHIC COMPLEXES IN THE KOLA SUPERDEEP BOREHOLE SECTION

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The researches were made within IGCP Project 408 (UNESCO). The main tasks of the Project are to compare properties of rocks in the section of the Kola Superdeep Borehole SG-3 (0-12262 m) and their homologues as well as geological correlation of the rocks in the SG-3 section with Precambrian formations of the Pechenga structure frame.

Present results are mainly based on a spectroscopic study of the extensive collection of samples of quartz (ca. 150) from the core SG-3 material and supposed rocks-homologues of the borehole area. ESR (electron spin resonance) was a main method for the study of quartz from the rocks. This method allows a selective registration of different atomic defects in the mineral structure. We used a multistage procedure of radiation-thermal influence on the mineral in order to reveal the highest possible diversity of atomic defects in quartz and facilitate their concentration evaluation. This procedure includes annealing at temperatures of 320, 530, and 1000 °C, and γ-irradiation of the samples by doses of 0.5 and 30 Mrad. ESR spectra of the powder samples of quartz were recorded at room temperature and boiling-point of liquid nitrogen with the commercial radiospectrometer SE/X 2547 (RadioPAN, Poland). The investigations were made on vacancy defects (E_1-centres) and defects associated with isomorphous incorporation of Al-, Ge-, Ti-ions into the lattice of rock-forming quartz.

The dependence of impurity-related Al-, Ge-, Ti-centres, and proper structural defects in the quartz along the SG-3 section on the bedding depth and petrogenesis of the Precambrian host rocks were estimated. Concentration shifts (vacancy defects) and redistribution of defects according to the structural positions (lithium and proton species of Ti-centres, Al-centres in regular and irregular positions) are evident.

The investigations carried out show that the impurities and structural defects in the rock-forming quartz can serve as a genetic mark for metamorphic rocks of the Precambrian formation complexes and as one of the criteria for typification and correlation of deep strata of the early Precambrian, exposed by the SG-3 section.

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