

Carbon Isotopic Studies of Calcite Veins Associated with U Mineralization in the Jahaz Deposit, North Delhi Fold Belt, Northwestern India

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Jahaz is one of the promising U deposits along the "albitite line" in the North Delhi Fold Belt, India, and is hosted within the Meso-Proterozoic metamorphic rocks of the Delhi Supergroup. The deposit is medium tonnage, low grade, metasomatic type, and structurally controlled. Quartzite, quartz biotite schist, and amphibolite are found to be deformed and albitized. The altered rocks have been classified into two groups based on petrographic studies: (1) less to moderately altered (LTMA) and (2) intensely altered (albitized). The major metamorphic mineral assemblages include hornblende, biotite, bytownite, quartz, muscovite, and almandine with a minor amount of sillimanite, andalusite, and ilmenite. Two types of calcite (calcite-1 and calcite-2) are distinguished based on the mode of occurrence and texture. Calcite-1 formed due to the replacement of parent mineral associated with the LTMA rocks. Calcite-2 occurs as vugs/veinlets in the albitized rocks. Calcite-2 is found to be in close association with uraninite and sulfide minerals (pyrrhotite, pyrite, chalcopyrite). Hence, we attempted the carbon isotopic analyses of representative calcite-2 veinlets using the isotope ratio mass spectrometers (IRMS) technique to infer the nature of hydrothermal fluid responsible for metasomatism and related U mineralization. The ranges of variation in $\delta^{13}\text{C}_{\text{VPDB}}$ and $\delta^{18}\text{O}_{\text{VPDB}}$ are relatively narrow, ranging from -6.18 to -6.51‰ and -19.93 to -21.03‰ , respectively. The isotopic data matches with the meteoric-derived hydrothermal fluid, and such fluid was responsible for metasomatism and U mineralization in the study area. The close association of uraninite and sulfides (pyrite, pyrrhotite, chalcopyrite, molybdenite) within albitized zones can be used as an effective exploration guide to delineate rich zones of uranium in similar geological settings.