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Ultrahigh-pressure eclogites: paleo-environment indicators
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UR REHMAN, Hafiz[1*]
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[1]Department of Earth and Environmental Sciences, Graduate School of Science and Engineering, Kagoshim
[1]Department of Earth and Environmental Sciences, Graduate School of Science and Engineering, Kagoshim

Ultrahigh-pressure (UHP) eclogites generally form by the metamorphism of mafic lithologies (gabbros or basalts) at depths greater than 90 km (minimum stability field of coesite) indicating P-T conditions of >2.7 GPa and 600-800 ◦C. At such conditions most minerals reequilibrate their chemical elements (e.g. major and trace and even isotopes) and new minerals crystallize or grow at the expense of other minerals formed during the magmatic crystallization. Some chemical elements, considered as relatively less mobile or immobile (e.g. Sm, Nd, Lu, Hf), are widely used for the extraction of past records the rocks have evolved through. Besides those elements, oxygen, the major component of silicates and oxides, impart important information related to protolith formation of rocks and their metamorphism. In general, most basaltic rocks show a narrow range of δ^{18}O (ca. +5.7 ± 0.3 ‰ relative VSMOW) and values for altered basalts vary from 0 to +12 ‰.

In this paper, I discuss the origin of low or negative δ^{18}O values; recently we found in the Himalayan UHP eclogites of Kaghan Valley and explain the mechanism how these low values were acquired. These eclogites are formed during Eocene by the India-Asia collision and their protoliths were the Panjal Trap basalts which were emplaced in Permian when Indian Plate was part of Gondwana. The δ^{18}O values are as low as — 2.25 ‰ in the fresh parts of eclogites and increase towards more positive in the retrogressed or amphibolitized parts. The unusually low δ^{18}O values in eclogites are interpreted to have resulted from the hydrothermal alteration of the protoliths by meteoric water interaction when Greater India was still at southern high latitudes (>65 degrees S) during the Permian indicating glacial paleo-environment. These low δ^{18}O values were frozen-in in the protolith rocks and did not change during subduction-related UHP metamorphism. However retrogressive process, due to infiltration of ^{18}O-rich fluids during exhumation, shifted these values towards more positive range.

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