Ultrahigh-pressure eclogites of the Kaghan Valley: Where they come from?

Hafiz Ur Rehman[1] and Tahseenullah Khan[2]
[1]*Department of Earth and Environmental Science, Kagoshima University, Japan*
[2]*Department of Earth and Environmental Sciences, Bahria University, Islamabad*
hafiz@sci.kagoshima-u.ac.jp

Abstract

The ultrahigh-pressure eclogites belonging to the Himalayan metamorphic belt, exposed on the Earth surface in the Kaghan Valley of Pakistan, were metamorphosed at pressure-temperature conditions of 2.7-3.2 GPa and 769 ± 50 ºC corresponding to mantle depth (>90 km). The pressure-temperature estimates were made using conventional geothermobarometers on the peak eclogite facies minerals (e.g., garnet, omphacitic clinopyroxene, phengite and coesite). The presence of coesite inclusions in omphacite in these rocks also confirms their depth of formation at mantle depth. Since, eclogites are mafic rocks, they usually form from the transformation of basaltic or gabbroic protoliths when subducted to considerable depth (eclogite facies stability field). The protoliths of the Himalayan eclogites were derived from an extensive volcanism along the northern margin of India when it was part of the Gondwana supercontinent. Based on the U-Pb zircon age-dating, the Panjal Trap basaltic volcanism occurred in Permian (ca. 267 Ma). After the break-up of India from Africa, Antarctica and Australia, the Indian continent moved northward and collided with Asia in the Eocene (ca. 50 Ma from the U-Pb zircon age-dating) near equatorial regions. Due to this continent-continent collision the Panjal Trap basalts, part of the subducting Indian lithosphere, underwent ultrahigh-pressure eclogite facies metamorphism at depth greater than 90 km (coesite stability field). In this paper, we will present a review on the evolution of the basaltic volcanism, the paleoclimate during that time when the volcanic activity was going on along the Indian margin, the northward drift of Indian plate, and the subduction-related ultrahigh-pressure metamorphism. Our petrological, geochemical, and geochronological results provide sufficient evidence how the Kaghan Valley eclogites formed, what were their source magma, how the metamorphic processes affected these rocks geochemically during their subduction to mantle-depth, and up to what extent these rocks retrograded during their exhumation to the earth's surface?