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THERMODYNAMIC MODELLING ON THE PEAK METAMORPHISM AND FLUID EVENTS DURING EXHUMATION OF THE TSO MORARI COESITE-BEARING ECLOGITE, NW HIMALAYA

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The advancement of computational petrology and the availability of relevant thermodynamic databases provide the mechanism to more precisely quantify metamorphic and metasomatic processes. In this study, we model peak metamorphic pressure-temperature (P-T) conditions of the Tso Morari ultra-high pressure (UHP) eclogite as well as multiple metasomatic events during exhumation. Modeling protocols use the Theriak-Domino program with dataset ds 62 and major metabasic mineral (garnet, omphacite, clinoamphibole, phengite, chlorite, lawsonite, talc, plagioclase, biotite, and quartz) activity-composition relations. The effect of garnet fractionation on the rock's effective bulk composition was considered when simulating prograde garnet growth. A "fishhook" shaped clockwise P-T path was obtained with a peak pressure of ~28.5 kbar at ~563 °C, followed by a peak temperature of ~613 °C at ~24.5 kbar.

Thermodynamic modeling using P-M(H_2O) pseudosections on Tso Morari eclogite matrix indicates three distinct phases of fluid events during exhumation. Fluid I occurs at ~610 °C and ~23.5 kbar with ~3.1 mol % fluid infiltration based on modeling of lawsonite break-down and epidote formation in the eclogite matrix. Fluid II occurs at ~19.0 kbar and ~610 °C with a limited abundance of fluid infiltration due to talc break-down through modeling the formation of amphibole in the eclogite matrix. Fluid III occurs at ~610 °C and ~8.7 kbar with a limited abundance of fluid infiltration due to phengite break-down, based on modeling of symplectitic association (amphibole, plagioclase, biotite, and quartz) formation surrounding omphacite and phengite in the eclogite matrix. This study demonstrates the need of using careful petrographic observations in parallel with thermodynamic modeling to achieve realistic results.