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Contrasting thermal histories from two high-pressure metamorphic sequences of the Nagaland Ophiolite Complex, NE India: Implication of subduction channel within the Neo-Tethys

Ao, A.[1] and Bhowmik, S.K.[1]

[1] Department of Geology & Geophysics, Indian Institute of Technology Kharagpur, India (email: ao.ali6@gmail.com)

Although the Early Eocene collision between India and Asia is well documented, the dynamics of Neo-Tethys subduction systems pre-dating this event is poorly understood. This is in part due to lack of continuous exposures of high-pressure (HP)/low-temperature (LT) metamorphic rocks all along the Indus-Tsangpo Suture Zone (ITSZ) that marks the boundary between the Indian and Asian plates. The Nagaland Ophiolite Complex (NOC), which is the eastern extension of the ITSZ, is the largest exposed section of a dismembered and tectonized ophiolitic suite of rocks in the Indo-Burmese ranges (IBR) with reports of sporadic occurrences of HP metamorphic rocks. Seen in this context, the NOC, which lies at the transition zone from N-S convergence between Indian and Asian plates to E-W convergence between Indian and Burmese plates, is ideally suited to study the pre-collision, deep subduction channel dynamics within the Neo-Tethys.

This study reports two HP metamorphic sequences with contrasting thermal histories within a serpentinite mélange: HP/medium-temperature (HP/MT) and HP/low-temperature (HP/LT). The HP/MT sequence which consists of a suite of amphibolites with or without garnet and sodic-calcic pyroxene, is polyphase metamorphosed, and records two overprinting metamorphic cycles (M_1–M_2), and looping counterclockwise metamorphic *P-T* paths as part of a single tectonothermal event. The M_1 metamorphic cycle records peak metamorphism transitional between amphibolite and hornblende-eclogite facies at 13.8 ± 2.6 kbar, 625 ± 45 ^{o}C (error two sigma values) and subsequent cooling and partial exhumation to greenschist facies. The M_2 metamorphic cycle reflects a second prograde burial to peak metamorphism in the epidote blueschist facies condition at 14.4 ± 2 kbar, 540 ± 35 ^{o}C and their final exhumation to greenschist facies condition. The M_1 metamorphism marks the first evidence for initiation of subduction of the Neo-Tethys from the eastern segment of the ITSZ. Reburial and final exhumation during M_2 are explained in terms of material transport in a large-scale convective circulation system in the subduction channel as the latter evolves from a warm nascent to a cold and more mature stage of subduction.

The HP/LT metamorphic sequence, best represented by a suite of finely banded lawsonite and epidote blueschists has recorded peak metamorphism at ~11.5 kbar, ~340 ^{o}C, hairpin clockwise *P-T* trajectory and apparent low thermal gradient of 8 ^{o}C km^{-1} at metamorphic peak, consistent with a cold and mature stage of subduction zone setting for the Nagaland blueschists.

These findings provide new insights into (a) the architecture of the downing Neo-Tethys in an intra-oceanic subduction system, prior to the final suturing between the Indian and Burmese plates, (b) the complexity of subduction channel dynamics, involving recurrent burial and exhumation cycles of the first subducted Neo-Tethys and (c) evolution of the thermal structure during oceanic subduction from an initial warm to a later cold and mature stage.