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グァテマラ・北部モタグア断層帯のテクトニックブロックの二回の沈み込み - 上昇サイクル
Two burial-exhumation cycles of tectonic blocks from the northern Montague fault zone, Guatemala

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The Motagua fault zone (MFZ) of central Guatemala is a sinistral suture between the Maya Block (North American Plate) and the Chortis Block (Caribbean Plate). High-P tectonic blocks occur in serpentinite-matrix melanges exposed immediately north and south of the MFZ. The northern MFZ (NMFZ) melange hosts warm-subduction related blocks of epidote eclogite and garnet amphibolite, whereas the southern MFZ (SMFZ) melange includes cool-subduction related blocks of lawsonite eclogite and blueschist. Both the NMFZ and SMFZ eclogites give indistinguishable Sm-Nd garnet-omphacite isochron ages of around 140-130 Ma (Brueckner et al. 2009), but K-Ar phengite ages of the NMFZ high-P blocks (77-65 Ma) are significantly younger than those of the SMFZ high-P blocks (125-116 Ma) (Harlow et al. 2004). Further petrological study especially on the NMFZ high-P blocks is needed to interpret the available age data, and hence to understand the tectonic evolution of this region. We present detailed petrological data of garnet amphibolite from the NMFZ melange exposed at Estancia de La Virgen.

Single garnet crystals in the studied sample consist of four distinct growth zones (Grt1, Grt2, Grt3 and Grt4) and grossular inclusions. Compositions of the four garnet generations are: Grt1 (Alm_{44-52} Sps_{5-13} Prp_{5-6} Grs_{28-41}), Grt2 (Alm_{37-43} Sps_{8-16} Prp_{1-2} Grs_{41-51}), Grt3 (Alm_{48-53} Sps_{3-4} Prp_{3-6} Grs_{38-41}) and Grt4 (Alm_{50-58} Sps_{2-3} Prp_{8-10} Grs_{30-38}). Grt1 occurs as highly corroded cores of the garnet crystals, and contains inclusions of epidote, omphacite (Jd_{28}), titanite and actinolite, indicating the first subduction-related metamorphism in the eclogite facies (M1). The second growth zone (Grt2) hosts inclusions of chlorite, hornblende/actinolite, albite/oligoclase, allanite/epidote, zoisite, K-feldspar, indicating relatively low-P/T metamorphism in the transitional greenschist/amphibolite facies (M2). Grossular (Grs_{72-86} Adr_{6-22} Sps_{1-7}) is exclusively present as discrete crystals included in an intermediate zone within Grt2. The third garnet generation (Grt3) is recognized as a skeletal/dendritic overgrowth on Grt2. Grt3 hosts abundant aqueous fluid inclusions in addition to an almost identical inclusion paragenesis as Grt2. Metamorphism associated with Grt3 growth (M3) could be related to a pulse-like hydrothermal event. The last garnet generation (Grt4) resulted from second subduction-related metamorphism (M4). The early phase of M4 took place in the garnet-unstable conditions, and is recorded as relic inclusions within matrix amphibole. This early M4 assemblage includes glaucophane, actinolite, pumpellyite, phengite (Si=3.58-3.70 apfu) and paragonite, indicating high-P/T type metamorphism in the transitional pumpellyite-actinolite/blueschist facies. The inclusion paragenesis within Grt4 is identical with the matrix assemblage that consists of edenite/barroisitic hornblende, albite/oligoclase, epidote, phengite (Si=3.38-3.45 apfu), chlorite, titanite and quartz. The matrix amphibole was slightly replaced first by glaucophane + actinolite and then by actinolitic hornblende during final exhumation. P-T conditions during Grt4 growth are estimated to be ˜550 deg.C, 1.1 GPa, and thus the K-Ar system of phengite have been closed after the thermal peak of M4.

By combining the available information, we presume that the NMFZ high-P blocks underwent, at least, two subduction-exhumation cycles with three main tectono-metamorphic phases: 1) the first subduction-related metamorphism (˜140-130 Ma), 2) subsequent thermal events at shallow crustal levels, and 3) the second subduction-related metamorphism (˜77 Ma) at the transitional oceanic to continental subduction setting.

References: Brueckner et al. (2009), EPSL 284, 228-235; Harlow et al. (2004), Geology 32, 17-20.

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