Pressure-Temperature path of glaucophane eclogites from Latto Hills (Togo): a record of the onset of "modern" cold subduction on Earth?

Mahyra Tedeschi[1,2], Pierre Lanari[2], Carlos Eduardo Ganade[3], Ariete Righi[4], Rafael Nunes[5,4], Bruno Vieira Ribeiro[6]

[1]Programa de Pós-graduação em Geologia, Centro de Pesquisas Manoel Teixeira da Costa, Institute of Geosciences, Federal University of Minas Gerais, Av. Antônio Carlos, 6627, Belo Horizonte, Brazil
[2]Institute of Geological Sciences, University of Bern, Baltzerstrasse1-3, Bern, Switzerland
[3]Geological Survey of Brazil, Avenida Pasteur 404, Rio de Janeiro, Brazil
[4]Departamento de Física/ICEX, Universidade Federal de Minas Gerais, Av. Antônio Carlos, 6627, 31270-901, Belo Horizonte, Brazil
[5]Department of Physics, Binghamton University, Binghamton, NY 13902, United States of America
[6]Timescales of Mineral Systems Group, School of Earth and Planetary Sciences, Curtin University, Bentley, WA 6102, Australia

The onset of widespread "modern" deep subduction (*i.e.*, rocks returning from depths > 100 km; conditions of ~26-28 kbar and ~500-900 °C) has been widely accepted to have begun in the Neoproterozoic, with a significant increase of occurrences during the Phanerozoic. Understanding whether the conditions and dynamics of deep subduction systems changed through the geological time and how they are influenced by the nature of the protolith (continental crust vs oceanic crust), however, remains highly debatable. The eclogites from Latto Hills in Togo record high-pressure metamorphism at ca. 608 Ma and are among the earliest ultrahigh-pressure occurrences on Earth (Ganade et al., 2014). Their origin and pressure-temperature history, however, remain poorly understood. In this study, pressure-temperature trajectories of a phengite-bearing glaucophane and a glaucophane eclogite with lawsonite pseudomorphs were reconstructed using quantitative compositional mapping, forward thermodynamic modeling, quartz-in-garnet barometry, and Zr-in-rutile thermometry. Bulk-rock geochemistry suggests that the glaucophane eclogites from Latto Hills represent metamorphosed oceanic crust. Quartz-in-garnet barometry indicates pressure peak conditions between ~2.7 and 3.0 GPa, in line with garnet isopleths at 570–600 °C and Zr-in-rutile thermometry. These "cold" pressure-peak conditions are similar to those recorded by eclogites from Lago di Cignana located in the Western Alps. The comparison between Latto Hills eclogite metamorphosed at ca. 600 Ma and those from Lago di Cignana metamorphosed at ca. 40 Ma suggests that the conditions and processes of deep subduction and exhumation might not have changed during this period.

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