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Thermodynamic modelling and petrochronology of Taconic eclogites of Newfoundland Appalachians: implications for exhumation mechanisms

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The earliest accretionary stage of the Appalachian orogenic evolution is the Ordovician Taconic orogeny. The Early Paleozoic Laurentian margin in the Baie Verte Peninsula of western Newfoundland underwent subduction, collision, and exhumation during the Taconic orogeny. This led to the formation and preservation of high-pressure rocks such as eclogite, which is rarely present, or preserved, elsewhere in the Appalachian orogen.

The study of the Taconic orogen is hindered by extensive metamorphic and structural overprinting that took place during several subsequent orogenic cycles (e.g., Salinic and Acadian). A field-oriented multiscale structural-petrological approach has been developed to separate structures related to the Taconic orogeny from structures related to later overprinting orogenic events.

Some of the new and exciting discoveries of this research consist of exceptionally well preserved eclogite outcrops that seemingly escaped most of the pervasive metamorphic overprinting related to later orogenic cycles, and eclogites that preserved exhumation-related structures and retrograde metamorphic assemblages. This allows for deciphering of the metamorphic evolution of the eclogites relative to structure and time, which is essential for unravelling the tectonic processes related to their subduction and exhumation.

Microstructural and EPMA analyses revealed that the metamorphic high-pressure peak eclogite paragenesis was followed by three subsequent and superposed amphibole generations during metamorphic retrogression: pargasite; katophorite; and actinolite, respectively. Phase equilibria modelling has been used to calculate isothermal P-M(H_2O) pseudosections with Theriak-Domino and Perplex to unravel the P-T paths the eclogites recorded.

Additionally, the presence of accessory phases such as apatite (pre- to syn-eclogitic), rutile (syn-eclogitic), and titanite (post-eclogitic) enabled to employ U-Pb geochronology to constrain the P-T-t evolution of the eclogites.

The relevance of fluids infiltration in promoting metamorphic retrogression of the eclogites will be assessed, and the possible mechanisms responsible for the exhumation of the Baie Verte Peninsula eclogites will be proposed by comparing their P-T-t evolution with other exhumed high-pressure terranes and with numerical models.