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Slab dehydration and fluid-producing metamorphic reactions in early subduction stages: the record of the metamorphic sole of the Mont Albert ophiolite (Quebec, Canada)

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Metamorphic soles found at the base of obducted ophiolites provide valuable information on the early history of the subduction / obduction system. Metamorphic soles are characterised by rocks originating from the ocean floor (basalts and sediments in variable proportions) metamorphosed up to granulite facies, where the intensity of metamorphism increases to the top of the unit, towards the contact with peridotite. Their mafic and less frequently pelitic lithologies make them sensitive recorders of their pressure-temperature conditions of crystallization and allow radiometric dating. In addition, metamorphic soles have directly witnessed slab dehydration as they underwent similar fluid-producing metamorphic reactions before being accreted to the mantle wedge peridotites (i.e. before “underplating”). The mechanisms of underplating remain uncertain, because of the somewhat obscure link between weakening through fluid production and hardening via garnet crystallization, with direct consequences on the rheology of the plate interface.

In this study, we document fluid-producing reactions occurring during the prograde history of the metamorphic sole of the Taconian (ca. 460 Ma) ophiolite from Mont Albert (Quebec, Canada). This metamorphic sole shows variably metamorphosed mafic and pelitic rocks with metamorphic gradients over the scale of 10 metres, with clinopyroxene-garnet-amphibole granulite facies mafic rocks at the contact with the overlying peridotites. Evidences of melting of pelitic lithologies increase towards the contact, and no remains of metapelites have been found within about 20 m from the contact. Fluid channelization and melt migration is evidenced by decimetric dykes and veins. Away from the contact, metamorphism intensity gradually decreases to greenschist facies with abundant hydrated silicates. The aim of the study is to provide constraints (i) on the nature of the fluids produced (aqueous versus melt), (ii) on their composition and (iii) on the pressure-temperature conditions of their production. This will allow a better understanding of the rheological behaviour of subducting slabs in subduction zones and of amphibolites in the lower continental crust.