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Rheology modification in subduction channels due to high pressure metasomatism (Rocky Beach Metamorphic Melange, Port Macquarie, Australia).

MELANIE A FINCH[1], ALANIS OLESCH-BYRNE[1], MARTIN BEILHARZ[2] AND ANDREW TOMKINS[2]

[1]James Cook University
[2]Monash University
Presenting Author: melanie.finch@jcu.edu.au

The rheological properties of the interface between the downgoing and overriding plates in subduction zones provides insight into how plate convergence is accommodated and the controls on seismic and aseismic slip. This interface is known as the subduction channel and exhumed examples provide direct information on dynamic feedbacks between metamorphism and deformation. The Rocky Beach Metamorphic Melange is one such subduction channel, composed of eclogite, blueschist and greenschist facies blocks within a melange matrix. The rocks were subducted to ca. 100 km depth and then retrogressed during return flow and exhumation. Despite their proximity, mafic blocks show marked differences in mineral assemblages due to metasomatism at different metamorphic grades during return flow. We determined how the metamorphic grade of metasomatism effects block rheology by comparing the deformation style of different blocks. While unmetasomatised eclogites behaved as rigid objects in the melange matrix, rocks that experienced eclogite facies metasomatism accumulated significant strain, forming isoclinal folds and refolded folds. Blocks that underwent blueschist facies metasomatism developed mm-scale isoclinal folds with shearing parallel to fold limbs forming rootless isoclinal folds. At the transition between blueschist and greenschist facies pressure solution became important, which preferentially focused along layers of lawsonite, dissolving it from the rock. At greenschist facies, pressure solution caused significant mass loss, producing mm-spacing between pressure solution seams and cuspate folds, analogous to dewatering structures in sediments. The Rocky Beach Metamorphic Melange is a spectacular example of metasomatism-induced changes in rheology during return flow, providing unique insight into how subduction channels accommodate plate convergence.