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Expulsion tectonics and return flow during continental subduction: P-T-deformation constraints from Oman.

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The northeastern continental margin of Oman in the Saih Hatat region is characterised by high-pressure (HP) chloritoid- or carpholite-bearing meta-sediments and highly deformed mafic eclogites and blueschists in a series of tectonic units bounded by high-strain ductile shear zones. New data on the upper, carpholite-bearing cover units of this HP nappe stack indicate that all of them underwent similar P conditions to the underlying Hulw structural unit (with a cooler exhumation P-T path). Early SSW-directed crustal thickening during ophiolite emplacement created recumbent folds and strong schistose fabrics in these Permian–Mesozoic shelf carbonates and was followed by later NNE-dipping normal sense shear zones (namely the Hulw, Al Wudya, Yenkit, Al Hamriyah shear zones) and normal faults. In particular, the Mayh unit shows high strain in a 15-25 km long sheath fold that likely formed at carpholite grade pressures of 8-10 kbar and depths of $\sim$30 km. We show that there are no significant P differences across the Hulw shear zone ('upper plate – lower plate discontinuity') or the overlying Mayh, Yenkit-Yiti and Ruwi units, nor between them. Post-peak metamorphic exhumation of the HP rocks was therefore accomplished by bottom-to-SSW (rather than top-to-NNE) active footwall extrusion beneath a fixed, static, passive hanging-wall. Footwall uplift beneath these passive roof faults resulted in progressive expulsion of the HP rocks from depths of $\sim$80-90 km (eclogites) and mainly 30-35 km (blueschists and chloritoid/carpholite-bearing units) during the Campanian – Early Maastrichtian. Oman thus provides a detailed record of how continental material (thick platform shelf carbonates) progressively jammed a subduction zone and emphasizes the contrasting behaviour between cover units and their underlying basement. HP ductile shear zones evolved into brittle normal faults with time during exhumation towards the surface.