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Imaging high-pressure rock exhumation along the arc-continent suture in eastern Taiwan

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Imaging high-pressure rock exhumation in active tectonic settings is considered to be one of the important observations that could potentially help to move forward the understanding of how this process works. Petrophysical analyses carried out along a high velocity zone imaged by seismic travel time tomography along the suture zone between the actively colliding Luzon Arc and the southeastern margin of Eurasia in Taiwan suggests that high-pressure rocks are being exhumed from at least a depth of 50 km below the arc-continent suture to the shallow subsurface where they coincide with an outcropping tectonic mélange called the Yuli Belt. The Yuli Belt comprises mainly greenschist facies quartz-mica schist, with lesser metabasite, metamorphosed mantle fragments and, importantly, minor blueschist. Modeling of published data bases of measured seismic velocities for a large suite of rocks suggests that all of the Yuli belt lithologies fit well with the measured Vp, Vs, and Vp/Vs at ambient pressures and temperatures (a 20 oC/km geotherm is used) from 10 to about 20 km depth. With the exception of hornblendite, mantle rocks need 30% to 40 % serpentinization to approximate the in situ range of Vp and and Vs at these depths. From about 20 km to 30 km, most continental crust and volcanic arc lithologies move out of the range of velocities measured by the tomography model at these depths. Blueschist (including the calculated Vp and Vs for the Yuli Belt samples), pyroxenite, and harzburgite, lherzolite, and dunite with around 20% to 30% serpentinization now enter into the range of velocities for these depths. From 40 km to 50 km depth, the mantle rocks pyroxenite, and weakly to unserpentinized harzburgite, lherzolite, and dunite, together with mafic eclogite velocities best fit the range of Vp, Vs and Vp/Vs at these depths. Seismicity along the arc-continent suture, the upper bounding fault of the high velocity zone examined here, indicate that it is a moderately oblique-slip thrust. The western boundary is a near vertical, sharp velocity gradient that, in the upper 10 to 15 km appears to link with a sinistral strike-slip fault. The high velocity zone itself is very seismically active down to a depth of 50 km. Focal mechanisms determined from within the high velocity zone are mostly strike-slip, oblique-slip, and extensional, with rare thrust mechanisms.