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. Petrophysical modeling of a published database of measured seismic velocities for a large suite of rocks was carried out to see what lithologies best fit the high-velocity zone. Vp and Vs from this database were tempertature corrected for a geothermal gradient of 10 ^{o}C/km and for an effective pressure using a λ (pore fluid pressure/confining pressure) of 0.75. This analysis suggests that all of the Yuli belt lithologies fit well with the measured Vp, Vs, and Vp/Vs 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. Finally, the high-velocity zone is very seismically active, with earthquakes occurring to a depth of 50 km. Focal mechanisms for more than 40 of these earthquakes with $M_L > 3.5$ were determined. Of these, 10 events were picked for full wave form modeling to decompose them into double-couple and compensated linear vector dipoles (CLVD) to test whether or not mechanisms other that faulting (i.e, fluid movement) are active within the high-velocity zone. All ten events show a small CLVD component, but they are mostly double couple. This indicates that for earthquakes of this magnitude, faulting is the dominant mechanism.