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Water Release from Cold Serpentinized Forearc Mantle During Subduction Associated with Changes in Incoming Oceanic Plate Thermal Structure and Plate Boundary Kinematics: New Insights into Serpentinite Belts and Plate-Boundary Rheology

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Kirby, Wang, and Brocher (Earth Planets and Space, 2014) recently showed how the change in kinematics of the California margin from subduction motion to continental transform motion with the birth and growth of the San Andreas Fault System (SAFS) beginning at about 33 Ma BP likely led to a warming of the former forearc mantle and the release of water from serpentinized mantle by dehydration and a likely increase in fluid pressures along the SAFS. Such a mantle source of pressurized water gives insights into both the low sliding resistance for the SAFS and the mobilization and ascent of some serpentinized mantle peridotites through the crust. Thermal modeling by others has also shown that changes in the incoming plate age and subduction rate can also lead to warming of the forearc mantle during subduction. This development gives insights into the Mesozoic and Paleogene ages of emplacement of some, but not all, California serpentinites. Recent mineralogical and geochemical observations of serpentinite blocks in serpentinize mélange bodies in the San Francisco Bay Area (Uno and Kirby, 2014 AGU Meeting and Lewis and Kirby, 2015 AGU Meeting) suggest that these rocks sustained multiple stages of serpentinization that are broadly consistent with the model of Kirby et al. (2014). A new development comes from interpretation of investigations in the literature of localized late-stage silica-carbonate-water alteration of serpentinite bodies in California that this alteration occurred largely in Neogene time when the highest rates of water release from the former forearc mantle probably occurred. This presentation also suggests that the occurrence of serpentinite belts emplaced in Cenozoic time during changing plate-boundary kinematics, such as the Cenozoic closing of the Tethys Ocean bordering Eurasia by subduction and collision and arc reversal and decreasing convergence rates under the Greater Antilles and Colombia and New Guinea, may give insights into the serpentinite belts in those regions. The weak rheological behavior of present collisional plate boundaries under high fluid pressures from the mantle also provides possible explanations of the mobility of "tectonic escape" strike-slip faulting in Turkey, Syria, and SE Asia following subduction.