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A melange of subduction temperatures: Zr-in-rutile thermometry of the Catalina Schist and implications for subduction interface rheology

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The Catalina Schist contains a spectacular, km-scale amphibolite facies mélange zone, thought to be part of a Cretaceous convergent margin plate interface. In this setting, mafic and ultramafic blocks ranging from cms up to 100s of m in diameter are surrounded by finer-grained matrix that is derived from the blocks. All blocks throughout the mélange contain assemblages consistent with upper amphibolite-facies conditions, suggesting a relatively restricted range of depths and temperatures over which the mélange formed. This apparent uniformity contrasts with other mélanges, such as the Franciscan Complex, where rocks with highly variable peak metamorphic grade suggest extensive mixing of materials along the subduction interface. This mixing has been ascribed to flow of material within relatively low viscosity matrix. The Zr content of rutiles in 26 blocks and 1 matrix sample from the amphibolite facies of the Catalina Schist were measured to determine peak metamorphic temperatures, identify whether these temperatures were different among blocks (within measurement error), and whether the spatial distribution of temperatures throughout the mélange was systematic or random. Resolvably different Zr contents, between 290 and 720 ($\pm$10-40) ppm, are found among the blocks, corresponding to different peak metamorphic temperatures of 650 to 730 ($\pm$3-15) °C at an assumed pressure of 1 GPa. These results are broadly consistent with previous thermobarometric estimates. No systematic distribution of temperatures was found, however. Like other mélange zones, material flow within the Catalina Schist mélange was likely chaotic, but appears to have occurred on a more restricted scale compared to localities such as the Franciscan. Progressive metamorphism of mélange matrix is expected to produce rheologically stiffer matrix minerals (such as amphiboles and pyroxenes) at the expense of weaker matrix minerals (sheet silicates), affecting the overall rheological behavior of the mélange, and dictating the scale of flow. The Catalina Schist amphibolite facies appears to provide a snapshot of hotter, stiffer portions of a subduction interface, presumably more representative of rheological behavior at depths approaching the subarc than is found in other exhumed mélange zones.