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Blueschist Blocks in the Shale-matrix Melange of the Franciscan Complex of California: Metamorphic Aureoles and Subduction Channel Upwelling

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The subduction channel concept postulates that where oceanic lithosphere converges faster than $\sim$2 cm/yr, the plate boundary is best approximated as a viscous shear zone. Channel capacity can abruptly decrease where there is a sharp increase in the pressure gradient along the top of the shear zone. Where this occurs, subducted sediment can upwell and flow back towards the inlet. The Central Belt of the Franciscan Complex is up to tens of km wide and extends from where subduction continues in Oregon southwards to the Nacimiento Block, west of the San Andreas fault. The scaly shale matrix outcrops poorly along the 1500+ km belt because it is weakly metamorphosed (<200°C, pumpellyite$\pm$lawsonite-bearing). The best exposures, as pointed out by Ken Hsu in 1969, are found near San Simeon. The Central Belt mélange is renowned for the "high-grade" garnet-bearing blueschists (e.g., Tiburon, Jenner Beach). How these high-T blocks, the oldest metamorphics in the Franciscan and the more voluminous lower-T blueschists became rounded fragments encased in shale-matrix has been the subject of much discussion. Uplift in serpentine diapirs is widely invoked, but the scarcity of these blocks in serpentinite where exposures are good is problematic. Explaining the blocks as sedimentary olistoliths requires both a phantom source terrane and exhumation mechanism. The simplest explanation is that the coarse blueschists are fragments of a metamorphic aureole formed during subduction initiation that were later detached from the base of the ophiolitic leading edge of the North American plate. Later, tectonic melange was generated by subduction-driven shearing that caused upwelling of shale-rich sediment. Slabs of blueschist were boudinaged and mixed with fragments of greenstone and chert detached from seamounts. Blueschist block incorporation into upwelling mélange is a kind of subduction erosion akin to plucking by glaciers. The exposure of the blueschist along the roof of the subduction channel may have been mostly localized to near where normal faults formed in the overriding block as Farallon plate dip flattened from 80 to 40 Ma. Only blocks of the appropriate size and density can upwell to shallower depths where they are accreted by underplating or offscraping. Blocks that are large and dense enough to sink faster than the rate of upwelling, bottom out and become subducted.