Abstract ID: 211

Title: THE FRANCISCAN AND KINDRED SUBDUCTION COMPLEXES, 40 YEARS A.D. (AFTER DICKINSON)

Student: No
Topic: Tectonics
Medium: Invited Oral Presentation

Author 1 (CONTACT AUTHOR)
Name: Darrel Cowan
Org: University of Washington
Country: USA

Keywords: Franciscan, subduction complex, melange, critical wedge

Abstract: Forty years ago, the geologic signatures of plate boundaries were just being recognized and appreciated on continents. Dickinson, Ernst, and Hamilton interpreted the Franciscan assemblage in California as part of the great triad that resulted from late Mesozoic subduction of oceanic crust beneath the western margin of North America. A few nagging questions about the Franciscan have persisted to the present. How did the materials that were metamorphosed under high P/low T conditions return to the surface? How did the infamous broken formations and mélanges, characterized by stratal disruption or an aspect best described as “blocks-in-a-matrix”, form?

In the early 1970’s, a prevalent conceptual model of how accretionary prisms or subduction complexes evolve was greatly influenced by the few available crude seismic reflection profiles from active convergent plate boundaries. We pictured oceanic crust and overlying trench sediments as being sequentially accreted as imbricate thrust slices. We recognized that this mechanism is not capable of elevating deeply buried metamorphic rocks and emplacing them onto or amongst rocks that had never been buried as deeply, even though evidence from the Franciscan demanded such material paths. Also, surveys of ocean-floor bathymetry were unrefined and incapable of revealing the role, if any, of mass wasting on the trench slope and at the toe of the prism. Notwithstanding these problems, the Franciscan quickly assumed almost revered status as the type subduction complex.

Forty-odd years later, our understanding of not only how accretionary wedges evolve but also what they consist of has advanced primarily for two reasons, but ironically neither of them stem from the four decades of further research on the Franciscan. First, critical-wedge theory is a powerfully predictive explanation for the geometric form and evolution of orogenic wedges in general. Investigations of other wedges, such as Cascadia and the Southern Alps of New Zealand, have moved the spotlight from the faults and folds so beloved by structural geologists and emphasized instead the particle paths that materials experience as they are accreted or underplated and move into, through, and out of a wedge. Second, our greatly improved ability to image the seafloor has shown that mass wasting and the resulting mass-flow deposits are not only present but prevalent at most active subduction zones. Mass wasting of materials that had been accreted to form a wedge provides debris flows into and across the trench. The fate of most of these debris-flow deposits must be re-accretion or underplating. If the present is key to the past,

ancient accretionary wedges formed at convergent plate boundaries should contain mass-flow deposits, some of which record deformation by wedge-centric processes. Lessons such as these, gleaned from other active and ancient accretionary wedges formed during A- or B-type subduction, will advance our understanding of the Franciscan.