Early Accretionary History of the Franciscan Complex as Inferred from the Yolla Bolly/Black Butte Area of the Eastern Belt

Dr. Thomas C. MacKinnon

In Northern California, the earliest intact accreted rocks in the Franciscan are exposed in the Eastern Belt. The Belt extends uninterrupted over 200 km north to south and is differentiated from the adjacent Central Belt by a higher metamorphic grade, lack of mud matrix mélange and the presence of schist and semi-schist in some areas. The largest and most intact part of the Eastern belt is in the Yolla Bolly–Black Butte area. Here the rocks can be divided into three eastward dipping units based on textural grade: from east to west these are the South Fork Mountain Schist (SFMS), Valentine Spring semi-schist, and non-schistose Yolla Bolly rocks. The units are arranged in an inverse metamorphic gradient with the highest grade rocks (SFMS) faulted against the distinctively less metamorphosed Coast Range Ophiolite and Great Valley Sequence.

Project 1. The nature of the contacts between the three main units has been the subject of controversy for many years as some workers believe they are gradational while others favor thrust fault contacts (Log Spring and Sulfur Creek faults as mapped on the current 1:100,000 USGS map). Fault advocates believe that the faults were active after completion of blueschist facies metamorphism resulting in “jumps” in textural and metamorphic grade across the contacts. In addition, they believe the faults separate units of relative coherent internal stratigraphy or distinguishing rock type. The mapped faults are major features, extending over 60 km north to south. In order to help solve the fault versus gradational controversy, structure, stratigraphy, and textural grade were studied in a number of traverses that cross the supposed fault contacts. The data show that the contacts are clearly gradational in all areas studied except one: in Thomes Creek, a fault inferred to be of local, not regional extent, separates schist from semischist. Furthermore, structural and lithological relations show that the only regionally consistent defining feature of the three units is textural grade, not rock type or other stratigraphic features.

Project 2. Details of the accretionary process were studied in extremely well-exposed outcrops in Grindstone and Thomes Creeks. The outcrops were located using Google Earth. The dominant structural features are steeply dipping beds cut by subparallel thrust faults spaced ~100 to 600 meters apart, with the angle between bedding and faults usually ranging from 0° to 35°. Between faults, bedding continuity, though locally disrupted, is generally well-preserved. Data from other comparable areas indicate that individual faults can be traced laterally from a few to ~10 km, forming an anastomosing network. The faults represent primary accretionary surfaces along which “packets” of relatively intact rocks were accreted. This simple structural style is not commonly recognized elsewhere in the Franciscan as structure is typically more complex or exposures are inadequate. However, comparable examples have been mapped, the best known

being the Marin Headlands. Such areas of relatively simple structure are important in furthering our understanding of the accretionary process.

Biography: **Dr. Thomas Mackinnon** received BA and MA degrees in Geology from the University of California at Santa Barbara, and a Ph.D. in geology from the University of Otago, New Zealand. In New Zealand he worked on the regional geology of the Torlesse subduction complex. For over 25 years, he worked for Chevron in California, including eight years as coordinator of Chevron Stratigraphic Schools and many years working on the Monterey Formation. Tom continues to work on the general geology of the Eastern belt and on other Franciscan projects in Northern California.