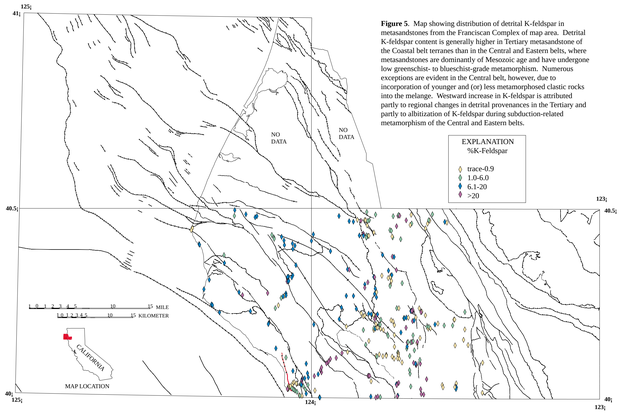


Figure 5. Map showing distribution of detrital K-feldspar in metasandstones from the Franciscan Complex of map area. Detrital K-feldspar content is generally higher in Tertiary metasandstone of the Coastal belt terranes than in the Central and Eastern belts, where metasandstones are dominantly of Mesozoic age and have undergone low greenschist- to blueschist-grade metamorphism. Numerous exceptions are evident in the Central belt, however, due to incorporation of younger and (or) less metamorphosed clastic rocks into the melange. Westward increase in K-feldspar is attributed partly to regional changes in detrital provenances in the Tertiary and partly to albitization of K-feldspar during subduction-related metamorphism of the Central and Eastern belts.

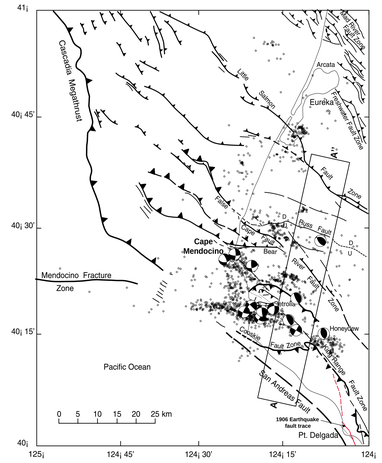


Figure 6A. Map showing distribution of epicenters (open circles) and selected focal mechanisms (beach balls) of earthquakes to depths of 15 km in the Mendocino triple junction region for the period 1974-1991. Rectangle delineates epicenters and focal mechanisms shown in Figure 6B. Red fault delineates Holocene trace of San Andreas fault associated with the San Francisco earthquake of 1906 (Prentice and others, 1999). Focal mechanisms are lower hemisphere projections; black sectors are tensional, white sectors are compressional. Location data and focal mechanisms from M. Magee (Stanford University and USGS), 1994.

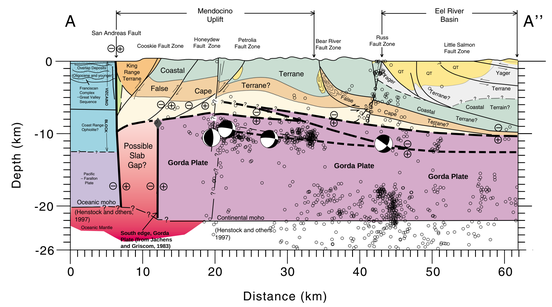
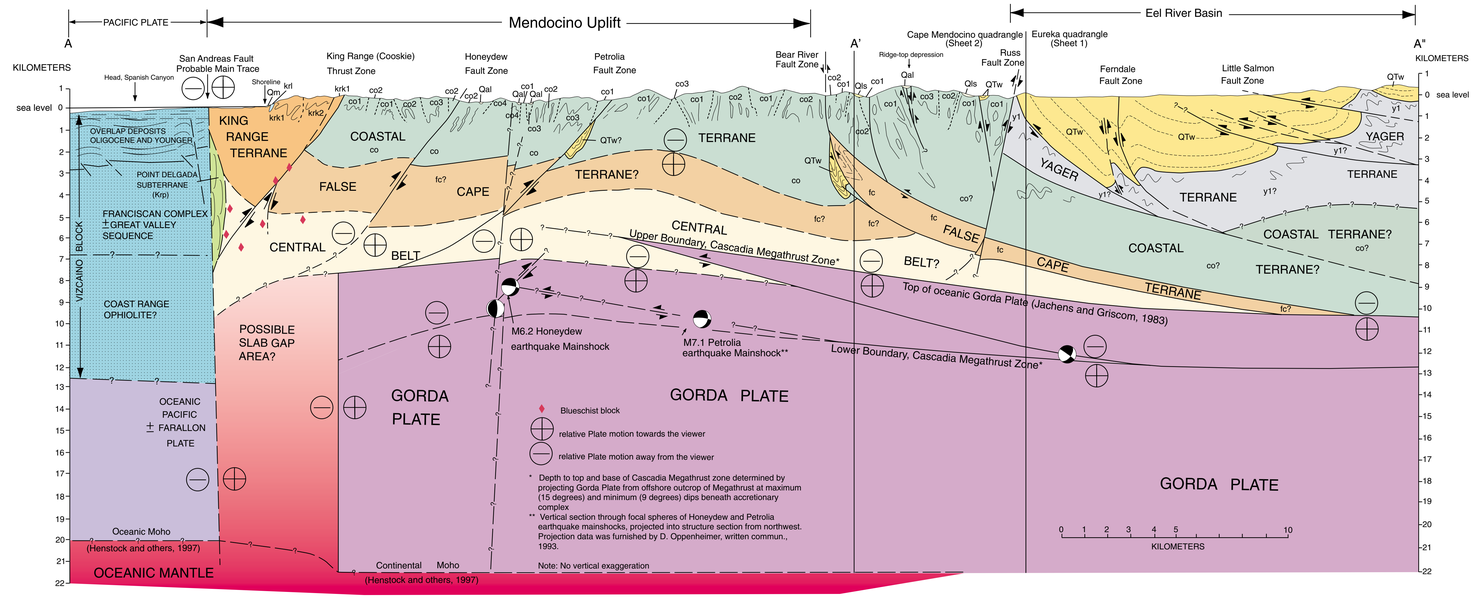
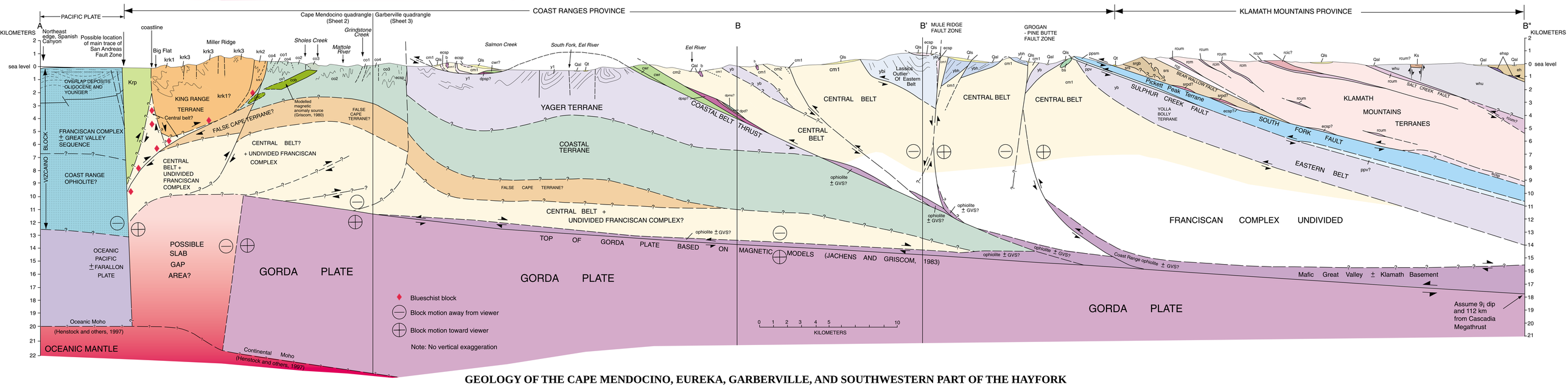


Figure 6B. Structure section A-A" showing depth distribution of epicenters (open circles) and selected focal mechanisms (beach balls) of earthquakes from M. Magee (Stanford University and USGS), 1994. Focal mechanisms are depicted as spheres viewed from the southeast, in section A-A"; black sectors are tensional, white sectors compressional. Seismicity below 12 km is associated with deformation within the Gorda Plate. Thrust focal mechanisms for Honeydew and Petrolia earthquakes indicate interaction between the Gorda and North American plates, probably along Cascadia Megathrust. Strike-slip events in the upper Gorda Plate that plot along the at-depth projection of the Honeydew fault zone and Mattole Road lineament (see fig. 3), reflect encroachment of the Pacific plate and the San Andreas fault system into the southern Cascadia subduction realm. These strike-slip events define a diffuse steep-dipping zone within the southern Gorda plate. Another steep south-dipping zone of seismicity extends from the surface to the top of the Gorda Plate and appears to be associated with the Russ fault zone. Location data and focal mechanisms from M. Magee (Stanford University and USGS), 1994.





STRUCTURE SECTIONS

The crustal structure depicted on these cross sections is largely schematic but is an attempt to explain fundamental structural relations observed at the surface across the map area. We acknowledge, however, that the data used to constrain deep crustal structure may be interpreted in several ways and that other models could explain the geology equally as well. The deep structure beneath some of the area crossed by these sections has also been interpreted differently in recent geophysical studies. Several of these studies are cited herein. Some of the authors of this report, moreover, do not agree with all the details of the structure as depicted in these sections. The offshore stratigraphy and crustal structure below 3 km in the Vizcaino structural block south of the Mendocino fracture zone is particularly controversial (Leitner and others, 1998; Godfrey and others, 1998; McCulloch, 1987). There is also disagreement among the authors of this report and among recent seismic and aeromagnetic and gravity modeling studies, over the nature and structure of basement rocks beneath the Franciscan Complex in the Coast Ranges Province. These controversies include different interpretations of (1) the position and thickness of the underthrust Gorda Plate, (2) the distribution of magma and (or) asthenospheric material composing a controversial slab gap beneath the Coast Ranges, and (3) how far Klamath basement, Coast Range ophiolite, and Great Valley sequence strata might extend westward beneath the Franciscan Complex (Jachens and Griscom, 1994; Jachens and others, 1995; Godfrey and others, 1998). Some of the authors of this report disagree with the interpretation presented here, which depicts ophiolitic basement and Great Valley sequence as peeled up from beneath the Franciscan Complex along the Coastal belt thrust. One of the authors (A.S. Jayko) favors structural imbrication as an alternative to the tectonic wedging model presented here. The senior author (McLaughlin), therefore, accepts full responsibility for the deep structure as depicted here, acknowledging that some coauthors of this report disagree with all or parts of the interpretation.

The primary criteria for modeling the crustal structure are surface geologic map relations, structural and kinematic measurements, and deformation styles observed in surface outcrops. In the Eel River basin area, structure is depicted primarily from the work of Ogle (1953), Hoskins and Griffiths (1971), and Haller (1980). Maximum depths for projection of geologic and structural relations from the surface with reasonable confidence is here considered to be about 2-3 km. Below this depth, the crustal structure is highly speculative but partly constrained by geophysical data.

The geophysical data used to constrain the structure below 3 kilometers includes (1) Models from aeromagnetic and gravity data (Griscom, 1973; Griscom, 1980a,b; Jachens and Griscom, 1983; Griscom and Jachens, 1990; and Jachens and Griscom, 1994), (2) Models of crustal structure from recent seismic reflection and seismic refraction transects (Henstock and others, 1997; Leitner and others, 1998; Godfrey and others, 1998; Beaudoin and others, 1996), and (3) seismicity and focal mechanisms of recent earthquakes (Oppenheimer and others, 1993; Oppenheimer and Eaton, 1992). The geophysical data are used to constrain the thickness of and depth to the top of oceanic crust of the Pacific and Gorda plates, the dip of the subducted Gorda and Farallon plates beneath the North American plate, and the geometry of the northeastern boundary of the King Range terrane. The internal structure and rock units represented in the depth interval below about 4 km are otherwise highly speculative, based on assumptions derived from and a structural style suggested by seismic reflection and refraction studies within the map area and elsewhere across the San Andreas fault and in the Great Valley (Fuis and Mooney, 1990; Wentworth and Zoback, 1990; Ramirez, 1993; Unruh and Moores, 1992; Wentworth and others, 1984).

In structure sections A-A'' and A-B'', offshore structure is based on the work of McCulloch (1987) and Griscom (1973) data from recent seismic transects and the recent modeling of magnetic and gravity data. Based on a seismic velocity range of 0-4 km/sec (Henstock and others, 1997; Leitner and others, 1998; Godfrey and others, 1998; Beaudoin and others, 1996), the Vizcaino block is here shown as composed of folded, faulted, and undeformed Oligocene and younger overlap and basin deposits to a depth of about 3 km. These Neogene and Quaternary deposits are underlain to a depth of about 7 km by 2 to 4 km of rocks with a seismic velocity range of 4.5-5.9 km/sec, and are interpreted as accretionary rocks of the Franciscan Complex, ophiolitic rocks, and possibly Great Valley sequence strata. The Franciscan rocks could include the Central and Coastal belts. Beneath these rocks to a depth of about 13 km, we infer the presence of a mafic slab, modeled a few kilometers south of the map area as 5-6 km thick (Griscom and Jachens, 1990) and considered to be part of the Mesozoic Coast Range ophiolite. Oceanic crust of the Pacific plate (and Farallon plate?) is shown at depths between about 13 and 20 km, based on a lower crust seismic velocity range of about 7.2-7.3 km/sec (Henstock and others, 1997). The oceanic Moho at the San Andreas fault is placed at about 20 km (Henstock and others, 1997), below which is considered to be oceanic mantle.

In these structure sections, map units of the Franciscan Complex defined by topographic form on the geologic maps are annotated at the surface, but their contacts are only projected to shallow depths. Since these units are defined predominantly on the basis of surficial characteristics, their depth extent may be very shallow. Colors for topographic form units are therefore omitted from the structure sections. Instead, we use the colors for krk1, y1, and co1 to delineate all topographic form units in terranes of the Coastal belt, and the color for cm1 to delineate all topographic form units in the un-named sandstone and argillite of the Central belt.

The assignment of rocks below about 4 km to map units delineated at the surface is highly speculative. Inferred unit designations at depth could include more than one unit mapped at the surface. In these areas of the sections we have indicated the other units that could be present based on geologic inference and on the seismic velocity, aeromagnetic, and gravity models cited above. The eastern part of Section A-B'' was left uncolored below about 7 km, because that area of the section is assigned to the Franciscan Complex undivided and could also include other basement units of the Klamath Mountains and Coast Ranges.

GEOLOGY OF THE CAPE MENDOCINO, EUREKA, GARBERVILLE, AND SOUTHWESTERN PART OF THE HAYFORK 30 X 60 MINUTE QUADRANGLES AND ADJACENT OFFSHORE AREA, NORTHERN CALIFORNIA

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