DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF–1230

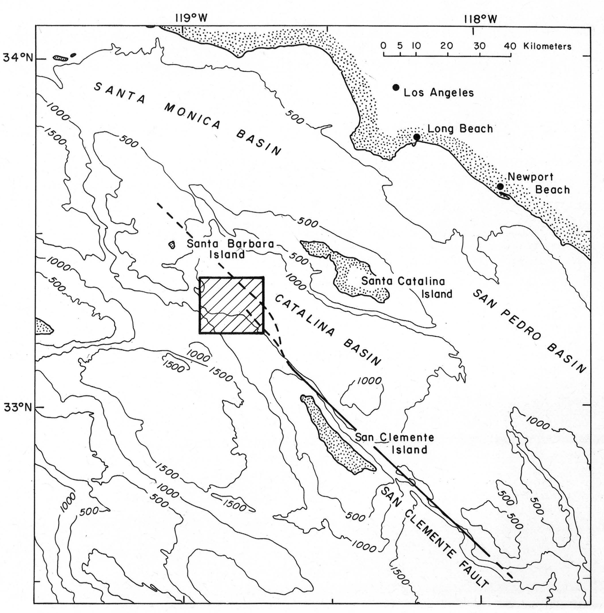
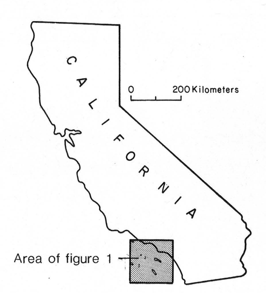


Figure 1 - Location map showing study area (hachured area) near San Clemente Ridge in California Borderland.



A deep-tow geophysical study of a small ridge along the north end of the San Clemente fault, informally termed Kimki Ridge by Arne Junger and J. G. Vedder (unpub. data, 1979), was conducted in April 1976 using the R/V Melville of the Scripps Institution of Oceanography. The purpose of the survey was to search for evidence of active faulting along the northward extension of the San Clemente fault, a major structural feature in the California Borderland (fig. 1).

The deep-tow instrument package includes precision echo sounding and 4.0-kHz high-resolution seismic-reflection and side-looking-sonar systems used in this survey, as well as photographic and physical oceanographic sensors and water samplers (Spiess and others, 1978).

The position of the deep-tow vehicle is usually fixed in relation to acoustic transponders placed on the seafloor. In this survey, however, bottom acoustic transponders were not available. Instead, a computer model of the towing operation, called the TOAD program (Ivers and Mudie, 1973), calculated the gross motions of the cable and vehicle during ship maneuvers, using the ship's position, the weight of the deep tow, and the weight and length of the towing cable. The resulting survey tracks compare favorably with approximate deep-tow positions derived by matching prominent topographic features monitored by the ship's echo sounder and by the deep-tow sensors. The TOAD program presumably gives a more accurate overall picture of the vehicle's behavior, because it can more precisely account for constantly changing ship speeds and towing cable lengths than can hand-made plots. The TOAD program positions for the deep-tow vehicle are probably accurate to within 50-100 m or better, except in short-radius corners (Ivers and Mudie, 1973).

The deep-tow precision echo-sounding data were used to refine the bathymetric contours of the original base map (National Ocean Survey Bathymetric Map 1206N-15). Because the new data generally matched the base map, they were used for a slight reshaping of previously recognized features, rather than large-scale recontouring (fig. 2). Recognizable bottom and subsurface geologic features and inferred contacts were plotted on the recontoured base map. The position of the east branch of the San Clemente fault, a deeply buried feature not visible on the deep-tow 4.0-kHz reflection system, was inferred from seismic profiles from a 1966 NURDC cruise (fig. 3; Ridlon, 1969). These seismic profiles show that Kimki Ridge is formed by a broad anticlinal structure in relatively well-bedded sedimentary rocks.

This deep-tow study shows one recently active fault that displaces surficial sediment on the west side of Kimki Ridge; this fault is designated the Kimki fault by Arne Junger and J. G. Vedder (unpub. data, 1979). The east branch of the San Clemente fault does not displace the uppermost sediments in the survey area (fig. 3). Slumping appears to be common on the flanks of Kimki Ridge and may be the cause of the nearly linear, downslope-trending bands of surficial roughness on side-scan sonar records. The roughness on the east flank of the ridge shows as long narrow bands on side-scan sonar. These bands are not recognizable in the seismic-reflection records, in contrast to the slump-induced roughness that is manifested by distorted upper sediment layers on the west side of the ridge. The slumping on the west flank seems to be associated with the steeper slopes along the Kimki fault

An exceptionally strong, irregular subbottom reflector along the crest of the ridge apparently is exposed locally in discontinuous outcrops in the eastern part of the study area (figs. 2,4). This strong reflector follows the crest of the anticlinal structure. Where this reflector is buried, it does not follow the general bedding across the ridge crest (fig. 4). Deeper reflecting horizons cannot be followed beneath this strong reflector, and below it, non-coherent high reflectivity throughout the section probably results from the irregular surface of the reflector itself.

Three explanations are possible for this feature. It may result from an accumulation of gas along the crest of the anticlinal structure of the ridge. Volcanic samples dredged by J. G. Vedder (oral commun., 1980) from the flank of the ridge suggest that a sill or dike may have intruded along the crest of the ridge. A volcanic source for the reflector could also account for its probable irregular surface. A less likely explanation for the observed high reflectivity is the presence of a buried bioherm (R. C. Tyce, oral commun., 1980). Further studies are required to determine the spatial extent and origin of this feature.

ACKNOWLEDGMENTS

We thank F. N. Spiess, chief scientist, and D. E. Boegeman, head of the deep-tow engineering group of the Marine Physical Laboratory, for the success of the shipboard operations. A. R. Tagg provided the shore-based electronic-positioning stations used during the survey, and Steve Miller and Kim Kastens assisted in post-cruise reduction of deep-tow positioning data. Discussions with J. G. Vedder, Arne Junger, and R. C. Tyce were helpful during preparation of the map.

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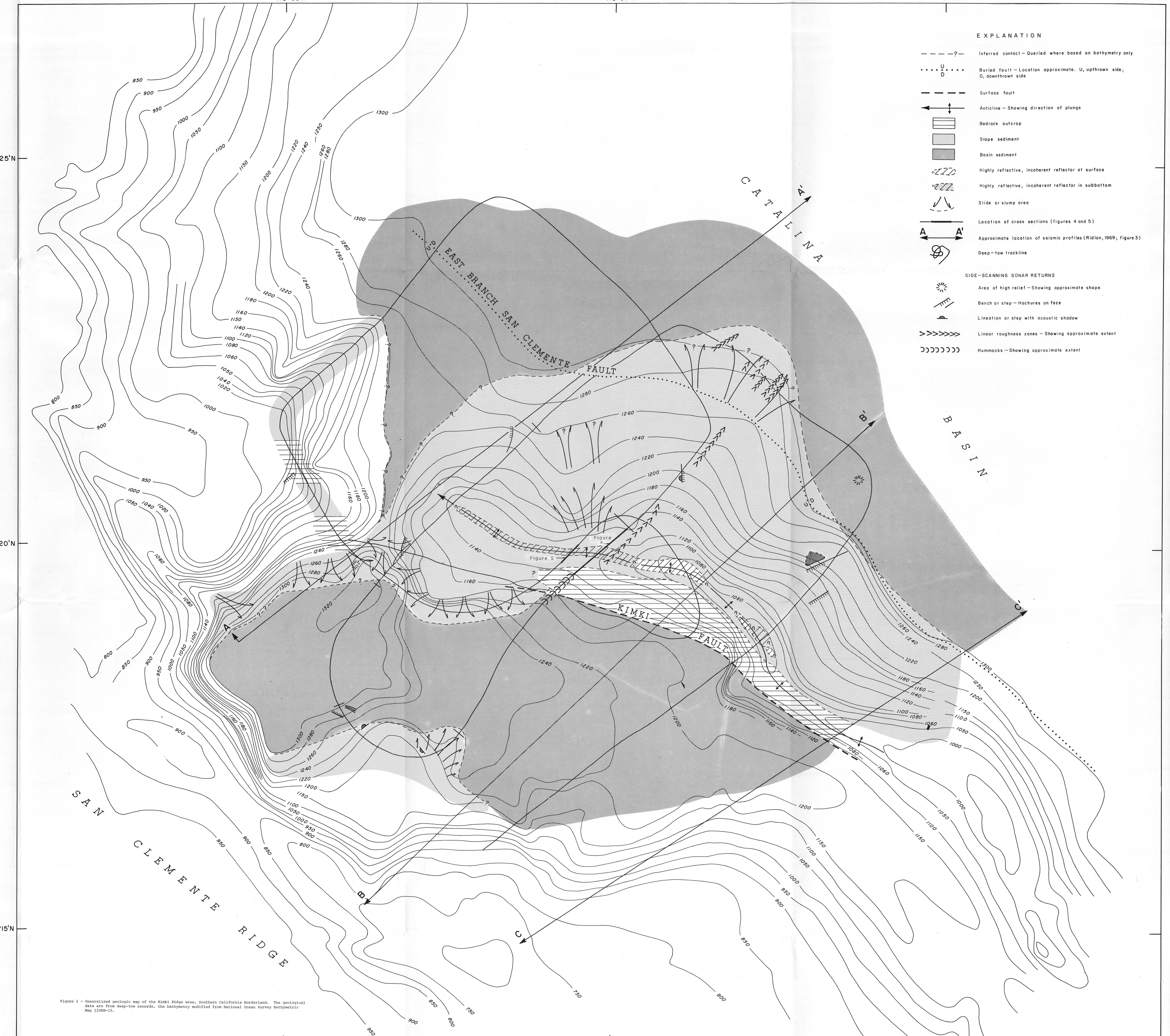

Figure 2 - Generalized geologic map of the Kimki Ridge area, Southern California Borderland. The geological data are from deep-tow records, the bathymetry modified from National Ocean Survey Bathymetric Map 1206N-15.

0 1 2 3 4 5 Kilometers
CONTOUR INTERVAL 20 METERS

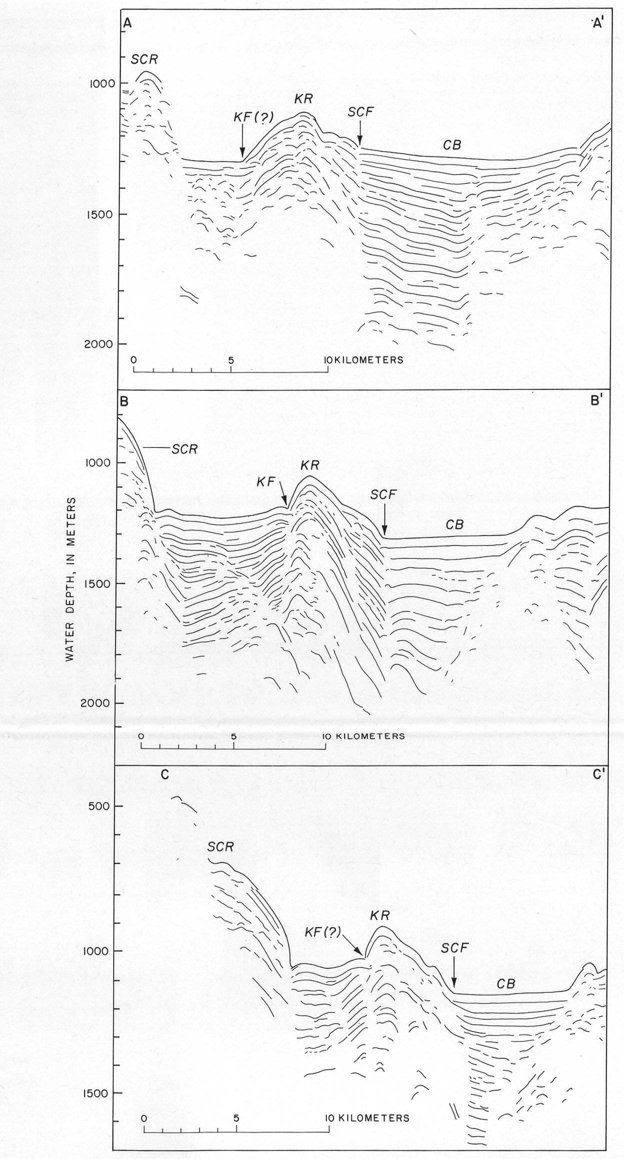

Figure 3 - Line drawings of seismic profiles (Ridlon, 1969) across San Clemente Ridge and part of Catalina Basin. The locations of the profiles are shown in figure 2 by lines A-A', B-B', C-C'. SCR, San Clemente Ridge; KF, Kimki fault; KR, Kimki Ridge; SCF, San Clemente fault; CB, Catalina Basin.

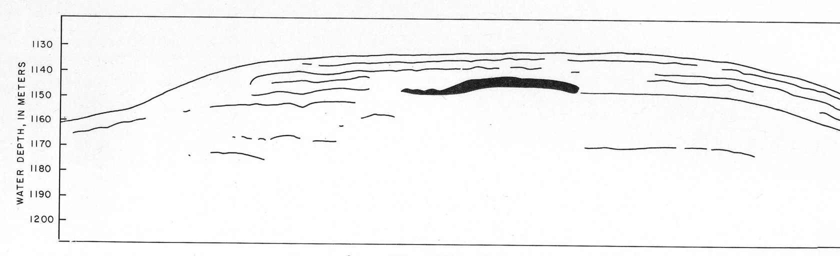

Figure 4 - Line drawing of 4.0-kHz seismic reflection profile, showing irregular reflector. The location of the profile is marked by the heavy line superimposed on the deep-tow trackline.

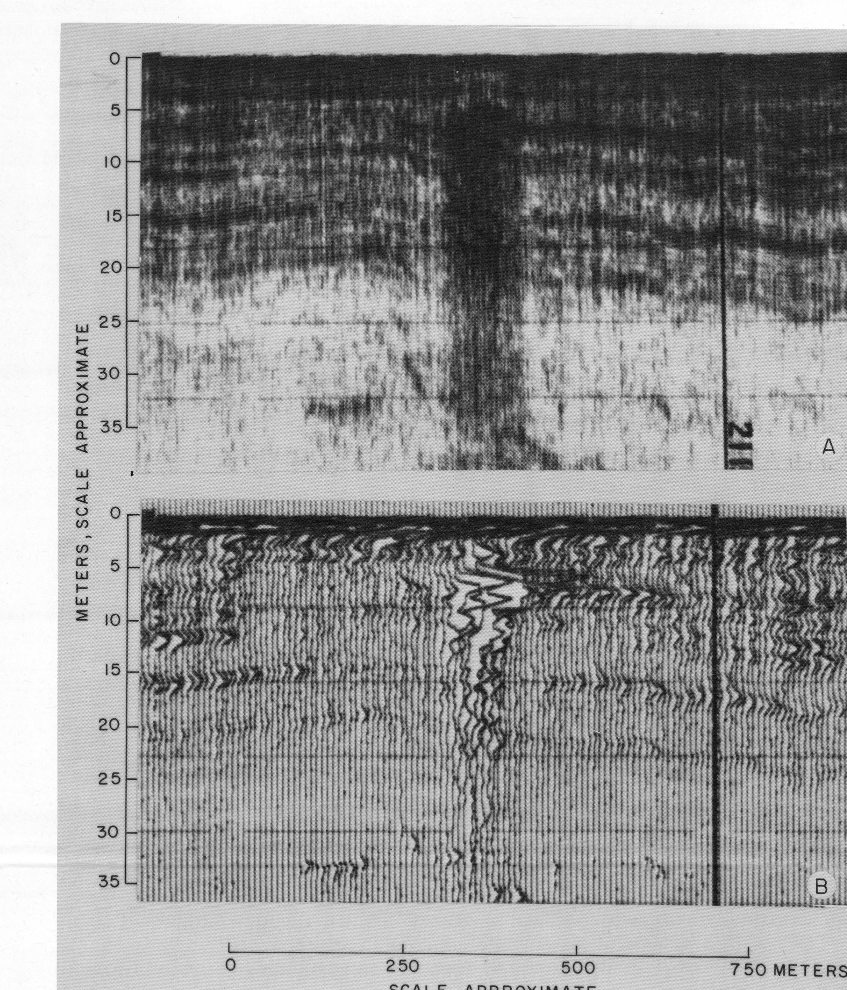

Figure 5. A. Expanded record of 4.0-kHz deep-tow seismic reflection profile of highly reflective surface where buried; seafloor relief reduced to horizontal datum.
B. Computer processed record of same data in A, showing high reflectivity of the irregular ridge crest reflector; see Tyce (1976) for description of processing techniques.

MAP SHOWING A DEEP-TOW GEOPHYSICAL STUDY OF THE NORTH END OF THE SAN CLEMENTE FAULT, CALIFORNIA BORDERLAND

By

George A. Ford and William R. Normark

1980

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