U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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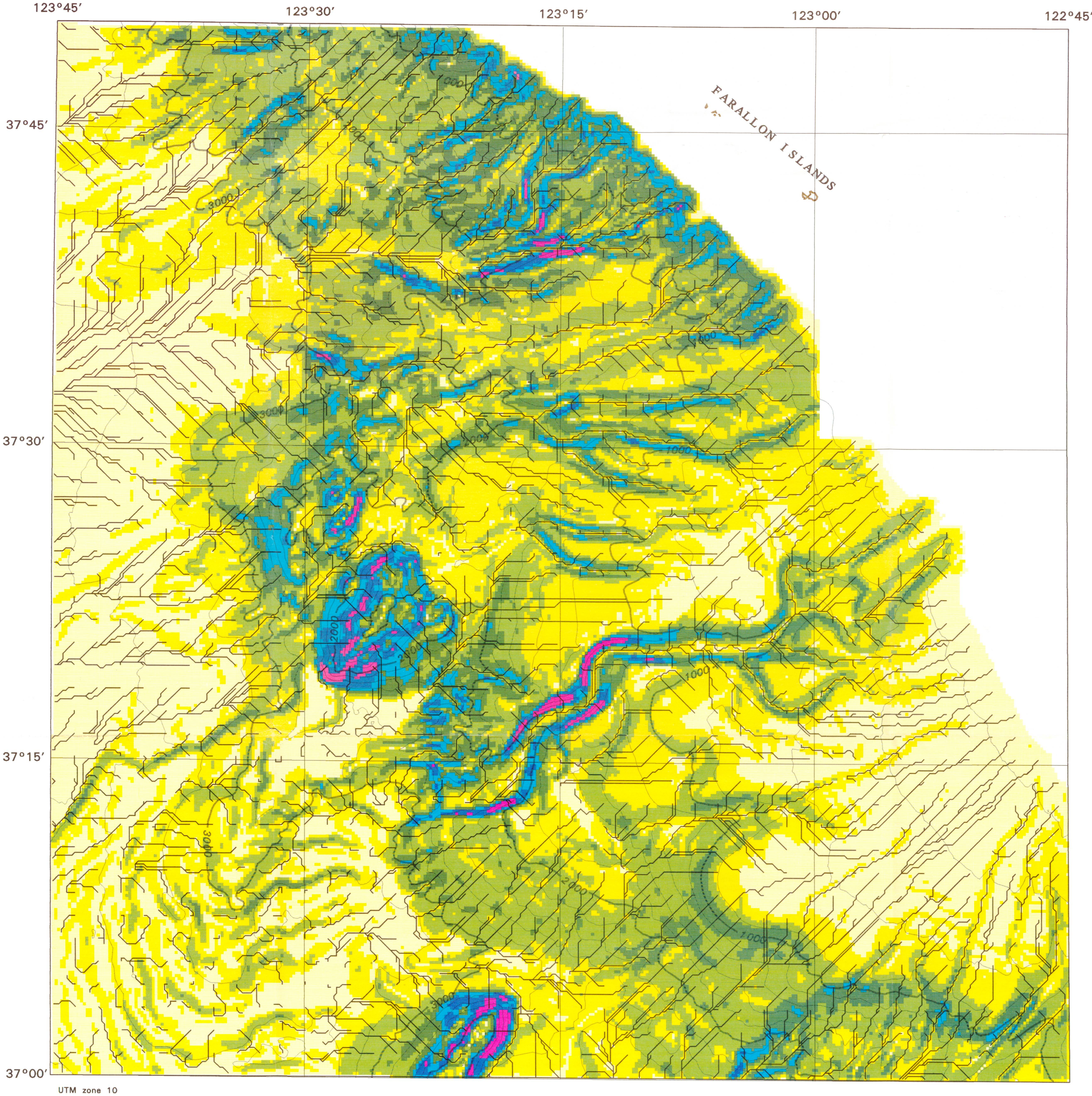

EXPLANATION

<=2 degrees

>2 to <=5 degrees

>5 to <=10 degrees

>10 to <=15 degrees

>15 to <=20 degrees

>20 to <=25 degrees

>25 degrees

Fall line

Bathymetric contour (interval = 200 m)

The accompanying map depicts the seafloor declivity and fall lines, displayed over a bathymetric base, on a portion of the continental slope in the Gulf of the Farallones, central California. The map was prepared as part of an extensive geophysical and sediment-sampling program whose purpose is to map and interpret the offshore geology of the Farallones region for application to resource and environmental concerns. The seafloor in the region is littered with debris that includes sunken ships and barrels of low-level radioactive waste.

Seafloor declivity is the slope of the seafloor measured from horizontal. A fall line indicates the direction of steepest slope. One application of this map is to evaluate the gravitationally induced movement of objects on the seafloor. Objects in areas of steep declivity are more likely to move in response to gravity than those in areas of shallow declivity, and if they do move, they will follow the general path of the fall lines.

The bathymetric contours, seafloor declivity, and fall lines were derived from National Oceanic and Atmospheric Administration (NOAA) multibeam bathymetric data. These data depths are accurate within 1% of true depths and have a positional accuracy of 75 meters (National Geophysical Data Center, Data Announcement 92-MGG-03, November 1992). The National Ocean Service (NOS), Coast and Geodetic Survey, Ocean Mapping Section produced gridded data sets from these raw data with grid nodes at 250-meter intervals. Computer programs and techniques were developed within the USGS to store, extract, manipulate, and display these data. Norman Maher contoured the bathymetry with the commercial software ISM.

ARC/INFO functions developed for hydrologic modeling were used to determine declivity and fall lines, using flow-direction and accumulated-flow routines (Environmental Systems Research Institute, Inc., 1992, Cell-based modeling with GRID 6.1: Redlands, California, Environmental Systems Research Institute, Inc., p. 1-1 to 1-13). Values of declivity were calculated for each 250-m grid node, then color-coded to represent declivity values that fall within 5-degree intervals, except for the shallowest slopes, which were subdivided into slopes less than 2 degrees and slopes from 2 to 5 degrees. The maximum declivity in this area is 33.4 degrees.

The network of fall lines produced at the 250-m grid spacing is too dense to be displayed at the 1:250,000 scale of the map. For this reason, we chose to initiate fall lines at every fourth grid node (a 2-km grid). The fall lines were extended iteratively by looking at the surrounding eight nodes and connecting the reference node with the node having the greatest negative difference (i.e., the greatest increase in seafloor depth). Thus, the directional precision of the fall lines is 45 degrees, the angle between the reference node and the successive surrounding nodes. The fall lines have no directional indicators, but direction can be deduced from bathymetric contours near a particular fall line.

The calculations for the fall lines expose local sinks - cells whose neighbors are all higher in elevation. Further calculations were not done to fill the sinks, which causes fall lines to end at midslope in some places.

Flow accumulation refers to the number of upslope cells that flow into a particular cell. A cell with zero flow accumulation is a topographic high. A cell with a high value of flow accumulation lies in a major channel. Fall lines are generated by connecting nodes with progressively greater flow accumulation downslope.

Map of Seafloor Declivity and Fall Lines on the Continental Slope, Gulf of the Farallones, Central California

SCALE 1:250000

by

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