

# PRACTICAL GEOLOGICAL RESOLUTION OF SEAFLOOR SURVEY SYSTEMS

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## LONG-TERM SCIENTIFIC OBJECTIVES

The long-range scientific interests of this work are in the geology of the ocean floor, particularly the processes controlling the generation and modification of oceanic lithosphere and their effects on abyssal morphology and character. Remote sensing acoustic optical instrumentation continues to play a fundamental role in determining the shape and nature of the seafloor. Therefore, understanding what the data from survey instrumentation are truly telling us about the seafloor morphology and structure is a major scientific objective.

## PROJECT OBJECTIVES

The research objectives are to compare the practical resolution of available marine geological/geophysical survey systems and determine which tools are most applicable for studying different types and scales of morphological problems. This involves determining the maximum amount of information it is possible to obtain from each tool by comparing its data with finer-scale knowledge obtained from higher resolution systems at the same location. The approach here is to analyze, when possible, actual representation of the geology produced by the survey systems, rather than relying solely on theoretical resolutions based on system engineering parameters.

## RESULTS

A variety of deep sea survey instruments (including GLORIA, SeaMARC II, Sea Beam, Deep-Tow, profiling sonars, camera sleds, and submersibles) provides a wide range of options in terms of swath widths, resolutions, sensor systems, and other capabilities, each with its own advantages and disadvantages. The ability of a given system to detect or represent seafloor features and character varies significantly both between systems and between types of feature. Resolution increases significantly with proximity to the target, so near-bottom systems provide the best representations. In general it is possible to interpret linear features to a finer resolution than equant ones of a constant minimum horizontal dimension. Comparison with the practical resolutions determined by evaluating coincident data sets show that the theoretical resolutions based on the design and geometry are generally a substantial overestimate of the level of detail one can actually expect to observe in the final images produced from the data. These theoretical values are useful in determining relative quality of different systems. One must, however, be careful not to overestimate systems abilities based on them when selecting a tool for attempting to address a particular problem which requires information at a particular set of scales. For these purposes, the resolution based on actual comparisons of multisensor and multiscale data provide the best starting point. Only once it is established that a certain set of systems is capable of providing the required degree of detail should emphasis be placed on swath coverage, survey speed, and cost.

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## PUBLICATIONS SUPPORTED UNDER THIS PROJECT

Kleinrock, M.C. Practical geological comparison of seafloor survey instrumentation, *Eos, Trans. Am. Geop. U.*, 70, 1304, 1989.

Kleinrock, M.C. and J.A. Goff, Quantitative comparisons of bathymetric survey systems, *Eos, Trans. Am. Geop. U.*, 71, 1624, 1990.

Shaw, P.R., D.K. Smith, and M.C. Kleinrock, Classification of heterogeneous topography through spatial flagging of non-Gaussian slopes: Application to the Galapagos propagator, *Eos, Trans. Am. Geop. U.*, 71, 1571, 1990.

Brooks, B., M.C. Kleinrock, and D.K. Smith, Morphometric and statistical characterization of small seamounts (volcanic knobs) at the Galapagos propagator, *Eos, Trans. Am. Geop. U.*, 71, 1571, 1990.

Goff, J.A. and M.C. Kleinrock, Quantitative comparisons of bathymetric survey systems, *Geophys. Res. Lett.*, 18, 1243-1256, 1991.

Kleinrock, M. C., P.R. Shaw, and D.K. Smith, Variations in Deformation Style Within Migrating Ridge Axis Discontinuities: Insights From Slope Distributions and Strain Patterns, *Eos, Trans. Am. Geop. U.*, 72, 466, 1991.

Phipps Morgan, J. and M.C. Kleinrock, Transform zone migration: implications of bookshelf faulting for oceanic and Icelandic propagating rifts, *Tectonics*, 10, 920-935, 1991.

Kleinrock, M.C., Capabilities of some systems used to survey the deep-sea floor, *CRC Handbook of Geophysical Exploration at Sea*, 2nd Edition, Hard Minerals, ed. R. Geyer, CRC Press, pp. 35-86, 1992.

Kleinrock, M.C., R.N. Hey, and A.E. Theberge, Practical Geological Comparison of Seafloor Survey Instruments: An Example from the 95°W Galapagos Propagator, *Geophys. Res. Lett.*, 19, 1407-1410, 1992.

Kleinrock, M.C., and B. Brooks, Construction and destruction of volcanic knobs at the Cocos-Nazca spreading system near 95°W; *Geophys. Res. Lett.*, in press.

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