New Applications of Computer-Based Section Construction: Strain Analysis, Local Balancing, and Subsurface Fault Prediction

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ABSTRACTS

An increase in the use of computers in structural geology now encourages practical investigation of several topics which are of considerable importance to the explorationist. Computer-based cross section construction and analysis is one such application. Algorithms based on the geometry of flexural slip or flow deformation styles permit rapid construction, restoration, and balancing of geological cross sections, which in turn allow evaluation of multiple working hypotheses in a time frame previously unattainable. These same techniques also simplify the application of several analytical methods which have tended to be restricted to structural geologists: predicted finite and incremental strain patterns within folds can be utilized in studies of porosity and permeability variation; the detailed geometry of fold can be evaluated and modified using local balancing methods when constraints provided by well, seismic, and surface data leave room for differing interpretations; and subsurface fault trajectories can be quickly and accurately predicted from knowledge or near-surface fold geometry. These and other methods discussed in the text permit the non-specialist to apply complex structural concepts of exploration in a practical and timely manner.

INTRODUCTION

Many recent innovations in cross section construction and analysis are not routinely applied owing to time constraints. Manual line-length restoration of a complex section to an undeformed state is a feared exercise for most workers; only rarely is there an option to perform several iterative restorations or to analyze the strain distributions inherent in a given structural interpretation. However, microcomputer systems can efficiently and precisely accomplish virtually all of the graphical procedures and geometrical methodologies necessary for cross section construction, restoration, and balancing, strain prediction, forward modeling, and fault prediction. This capability may be especially pertinent to industry applications: as hydrocarbon exploration evolves toward a search for ever smaller and more complex prospects, both cross section precision and viability are becoming increasingly important. In addition, the enormous time savings which result from computer analysis allow evaluation of multiple interpretations, an often difficult or impossible task using conventional manual techniques. The purpose of this paper is to illustrate some of the wide-ranging applications of computerized geological cross section construction, including brief discussions on the methodology and usefulness of including predicted strain distributions in the cross section analysis. Although the emphasis here is on compressional structures, computer-aided evaluation has been applied with similar success in extensional settings.

Whether done by hand or computer, the algorithms used to construct and restore a cross section must conform with observed structural geometries and, to a certain extent, with