Book Reviews

A Continental Rift

Rio Grande Rift. Northern New Mexico. W. SCOTT BALDRIDGE, PATRICIA WOOD DICKERSON, ROBERT E. RIECKER, and JIRI ZIDEK, Eds. New Mexico Geological Society, Socorro, 1984. xii, 379 pp., illus. $40; paper, $35. From a conference, Taos, N.M., Oct. 1984.

The annual reports of the New Mexico Geological Society's field conferences, although they contain detailed geological road logs (76 well-illustrated pages in this case), are much more than that, and students of active intercontinental rifting have long known that the papers in these volumes contain much otherwise unavailable information. The 1984 field conference represented a departure from earlier practice in being topical rather than regional. The conference was based in Taos, and the Rio Grande rift in northern New Mexico was the subject. There are contributed papers on nine broad topics: rift processes; tectonics, structure, and geophysics; stratigraphy, sedimentology, and paleontology; volcanic geology; Precambrian geology; economic geology; geomorphology and Quaternary geology; hydrogeology and water geochemistry; and archeology and history. There are full-page color plates showing a Landsat image, gravity and magnetics over the rift, and a tectonic map of the entire rift system.

Studies of continental rifts have progressed rapidly since the development during the last decade of elegant extension models and the widespread dissemination of modern seismic reflection profiles. It is now becoming possible to pose critical questions concerning such subjects as why the rift formed when it did and where it did. Morgan and Golombek in this volume report an evolutionary sequence for the Rio Grande rift suggesting that it was initiated close to (but not exactly over) an area of thin lithosphere associated with the last gasp of Laramide convergent igneous activity in New Mexico. Once initiated, the rift, like others, has developed in a complex way, responding to a variety of external tectonic influences.

Understanding of the complex development of a rift system depends largely on being able to date specific events in the history of the rift accurately. In the Rio Grande rift, as in most continental rift systems such as those of China and East Africa, sediment fill is nonmarine and poorly fossiliferous so that stratigraphic resolution is poor. Papers by Kelley and Duncan and by Manley address this difficulty by using fission track methods. The former have dated the uplift of high ground around the rift by determining the fission track ages of rift fill sediments, and the latter has used fission track methods to date stratiform volcanic rocks within the rift sequence of the Espanola Basin. The stratigraphy of the Albuquerque and San Luis basins has not yet been established with comparable resolution, and this task must represent an outstanding challenge to Rio Grande geologists.

Black reports for the first time on evidence of Laramide thrust faulting beneath the Espanola Basin. Workers in the Great Basin have lately been arguing about the extent to which Neogene extension is accommodated on older thrust planes, and it seems possible that the two processes may have been related in the Rio Grande.

Dungan and others report on the volcanic rocks of the Taos volcanic field. They add to their already published geochemical studies, which indicate the importance of magma mixing in petrologic evolution, by interpreting structural and topographic controls on individual flow distribution. Post-volcanic deformation of lavas erupted between 2,000,000 and 4,000,000 years ago includes faulting, tilting, and compression.

I can think of no comparable detailed structural analysis of a young series of volcanic rocks in a rift. The complexity that has been worked out in the Taos plateau volcanic field suggests to me that we should generally expect structural complexity in rift sediment and volcanic rocks.

Studies of the Rio Grande rift, because of exposure, accessibility, and resources, have long been in the forefront of rift research, and this magnificently produced book is a stimulating successor to earlier publications.

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Theoretical Physics

Application of Field Theory to Statistical Mechanics. L. GARRIDO, Ed. Springer-Verlag, New York, 1985. viii, 352 pp. Paper, $23.70. Lecture Notes in Physics, vol. 216. From a conference, Sitges, Barcelona, Spain, June 1984.

The analogy between quantum field theory and statistical mechanics was first developed systematically in the 1950's. With the advent of Euclidean field theory it became possible to put the connection in rigorous mathematical form. By now the two theories are so interlaced that it is hard to find an idea in one subject that has not been used in the other. Both are now in a full flood of development that is likely to last for decades. The book under review constitutes the proceedings of the 1984 Sitges Conference on Statistical Mechanics, and the contributors provide an interesting selection of current research. There are 13 main lectures and 22 shorter communications. Proceedings of this kind give, both to the beginner and to the more experienced in need of refreshment, an entry into current research developments. Typically, the individual contributions sketch main ideas and illustrate them in concrete examples; through their references one can find one's way to the main papers containing the details of experiment and argument. The present volume is an excellent specimen of this type.

Here are some samples of the book's contents. D. Nelson reviews the statistical mechanics of glass. According to his theory, the geometry of the packing of spheres plays a dominant role in the formation of the glassy state; a glass will contain a wild tangle of disclination lines formed in response to geometrical constraints. In addition to glasses, there are spin glasses, here considered in two contributions, one by C. de Dominicis and one by de Dominicis and I. Kondor. The theory of these substances has been one of the most active subjects in statistical mechanics in the last few years, and the theory that has resulted is marked by great ingenuity.

There are three contributions on surface effects. E. Brézin reports on recent work on the wetting transition. As he makes clear, it is not obvious that the elegant theory he develops will be applicable to experiment, because it assumes the absence of significant long-range forces, but if the day arrives the theory is ready. H. Wagner contributes an account of surface effects in second-order phase transitions. Here the problem is to