# SOME OBSERVATIONS ON PALEOGEOMORPHOLOGY

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Reconstruction of ancient landscapes and landscape processes have long been attempted, and continue to be, with varying degrees of success. The process is not trivial and demands a wide variety of data collected over broad areas by students in many disciplines and sub-disciplines. The last two or three decades have seen a tremendous growth in the volume and quality of these data. As a result we now might very well try some paleogeomorphic studies on regional or larger scales.

The vast supply of new data available to us include (1) those attendant on the development of the theory of plate tectonics, (2) the information derived from an ever expanding volume of geologic and geophysical mapping, and (3) the greatly increased number and quality of geologic dates, particularly those radiometrically derived.

To an increasingly sound base for the examination of past geomorphologies we can begin to add some quantitative methods for the determination of past erosion rates. We have had but modest control over this aspect of the development of past landscapes. Most of our quantitative evaluations of erosion rates are focussed, understandably enough, on the Recent. There are some new techniques, however, that can be of help in measuring rates in the geologic past, well into Phanerozoic time.

We measure an erosion rate by (1) determining the amount of material accumulated from an area over time in a collecting basin, or (2) by measuring the material in transport from an area in a given time, or (3) establishing the distance a point or surface in the underground moves toward a subaerial position in a given length of time. It is this last method for which some new tools have become available during the last decade or so. Four are given below.

1. The color of a <u>conodont</u> changes with temperature. Temperature may be equated, via the geothermal gradient, with depth. The fossil provides a time line. Time and distance being known, a rate can be estimated. Anita Harris, et al., (1978) have contoured the color changes in conodonts in the Appalachian Basin. These can be converted into con tours depicting lines of equal erosion.

2. <u>Metamorphic assemblages</u> have long been used to determine pressure and temperature conditions during their formation. Both P and T lead to estimates of depth. Using such information along with the information from <u>fluid inclusions</u>, radiometric ages, and general geology, Hollister (1982) has arrived at a rapid (2 mm/yr) uplift rate - by extension, an erosion rate - for a portion of the Coast in British Columbia.

3. The 40Ar/39Ar incremental release technique can provide not only a primary age for a mineral but also, in some instances, the age and temperature of a subsequent thermal event which has affected the mineral. Dallmeyer (1978) combines the 40Ar/39Ar method with other radiometric techniquess, metamorphic assemblages, and geologic mapping to produce a thermal and tectonic history from which erosion rates are derived. For example, in the Stone Mountain area of Georgia's Inner Piedmont he deduces erosional rates of 0.162 mm/yr from 365 to 220 my ago and gives data for a rate of 0.02 mm/yr from 220 my to the present.

4. Fission track dating provides the age of the annealing process in such minerals as apatite, sphene, and zircon. Annealing occurs at different temperatures in different minerals. If we equate depth with temperature we again have time and distance from which to determine rate. Zeitler et al (1982) used such data, along with petrologic analyses, field relations, and radiometric ages, to outline the uplift history of a section of the Himalaya in Pakistan. Uplift rates, at different times and in different settings, were determined to range from a low of 0.07 to 0.7 mm/yr. We may equate these uplift rates roughly with erosion rates.

Turning to another subject, we have long recognized climate as a major geomorphic determinant. Climatic information is available to us from the paleonologic and sedimentologic records. But a number of workers are trying to develop computer models of past climate. Here the work on peleoclimate and ancient landscapes can be mutually supportive.

## References Cited

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