PALEOMAGNETISM AND OROGENIC BELTS AT SEVERAL SCALES: SUCCESSES AND INHERENT LIMITATIONS

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ABSTRACT

Ever since Allan Cox reported paleomagnetic results from the Eocene Siletz River basalt flows from Oregon in the Pacific Northwest of the United States in 1957, and the data were subsequently reinterpreted as defining a quite large (>60°) magnitude of post-mid Cenozoic clockwise vertical axis rotation, which so typically characterizes this area, workers have well-recognized the potential of paleomagnetic methods for quantifying aspects of deformation of the lithosphere in a broad range of tectonic settings experiencing many styles of deformation. More specifically, efforts to quantify tectonic rotations in crustal (lithosphere?) elements, here defined as about a vertical to sub-vertical axis; tectonic tilting, typically in non-stratified rocks, here defined as about a horizontal to sub-horizontal axis; and latitudinal translations in response to tectonism and/or lithosphere plate reorganization have all met with considerable success using paleomagnetic data. Despite these successes, it must be recognized that important limitations are inherent in any paleomagnetic study addressing tectonic processes. Using attempts to quantify vertical axis rotations as an example, the determination of absolute rotations involves comparison of observed data with an independent, time-average geomagnetic field reference direction (typically derived from conventional or "synthetic" apparent polar wander paths for the lithosphere plate in question). The observed data must adequately average geomagnetic field behavior (not simple to define) and thus absolute rotation estimates, depending on the observed and "expected" inclinations, can be associated with associated errors that are less than satisfactory. Estimates of relative rotation, on the other hand, should involve comparison of data from the exact same rocks (e.g., a single lava flow or widespread ignimbrite) over a broad area, and they can be associated with errors less than a few degrees. The advent of modern geodetic techniques has led many geodesists to estimate rates of contemporary deformation processes; whether we can robustly extrapolate such efforts back in geologic time, utilizing paleomagnetic data, is currently debatable. A synthesis of the available paleomagnetic data from Turkey and surrounding areas, as well as a select area in the western United States, will be interpreted in the context of key tectonic processes.

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