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Palaeostresses deduced from striated faults: Are the data up to scratch?

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A major restriction on the application of fault-slip analysis methods is the availability of a collection of faults whose displacements where induced by the resolved shear stresses associated with a single stress tensor, and where the slip on individual faults are not influenced by the slip on other nearly faults. How does the prospective user of these methods know that the available data meet these requirements? To help answer this, the performance of fault-slip methods were examined when used to analyze unsuitable data; namely, faults and slip lineations with randomly chosen orientations.

A favourite criterion for judging data quality is the average discrepancy between the orientation of actual lineation on each fault and the lineation theoretically predicted from the best-fit tensor. However in this work it is found that random faults also yield small angular discrepancies in conditions where 8 or less faults are used. This criterion is only useful for large samples of faults.

Another test is to use the existence of tensors that are compatible with a given data set. For random data, there is possibility that tensors can be found that are capable of explaining the lineation orientation. For example, the existence of compatible stress orientations deduced from the right dihedron method is no proof of data meeting the assumptions of the method. The probability of finding such tensors depends on the tolerance used to assess fit, and the total number of trial tensors used. However a more useful check is to use the proportion of trial tensors that are found to fit random datasets. This proportion decreases rapidly with sample size. In sample sizes greater than five faults the expected proportion of tensors fitting is very small ($<1\%$). Statistical tests are proposed.

A powerful test on data quality is found to be one based on the consistency of the

best-fit tensors obtained from sub-samples of the data set. A bootstrap method is able to detect poor quality data from a lack of consistency in the resulting tensors.

This study emphasizes the dangers of palaeostress determinations from small numbers of faults. All of the tests of quality increase in power as the number of faults in the sample increases.