deformed rock. The states of stress and strain within different parts of a rock are rarely homogeneous with respect to direction and/or magnitude. Although these tend to be statistically homogeneous, stress sensitive fabric elements sometimes show large variations in their orientations and/or frequency. Accordingly descriptions of orientation patterns of the elements are necessarily statistical, as are any inferences drawn from them. Finally, it is important to keep in balance the scale of the fabric element and that of the field on which it is sampled in order to correctly evaluate the fabric. It is helpful, here, to consider the penetrative nature of a fabric element. For a fabric element to be penetrative the feature must be repeated statistically so that it effectively pervades the body and is present in the same average orientation in every sample. If the body is sampled on a scale smaller than the average spacing of the element, or if it is sampled on a scale larger than that pervaded by the element, the element becomes nonpenetrative (Ref. 4, p. 861). Hence, the fabric can be correctly evaluated only if penetrative fabric elements for a given size domain are studied.

Scope of the Paper

The primary purpose of this paper is to review dynamic petrofabric techniques now available for mapping principal stress directions in naturally deformed rocks. It is necessary to begin with the descriptive methodology employed in petrofabric analysis. This is discussed in some detail for the convenience of those readers not familiar with this subject. Included are sections on sampling and measuring, stereographic and equal-area projection, and the construction and statistical evaluation of petrofabric diagrams. This is followed by discussions of five important processes: fracturing, faulting, gliding flow, rotation, and recrystallization. As each process is discussed, the associated fabric elements are described and the literature is cited to demonstrate their usefulness in dynamic analysis.

Descriptive Methodology

Sampling and Measuring

Generalizations from observations on samples of the whole are merely statistical inferences, and the confidence within which a given statement can be made is related to the representative significance of the observations.[15,16] Systems are designed to facilitate and ensure sampling that will be representative of the features to be examined. The systems include consideration of the number and location of stations where the rock is sampled, as well as the number of measurements and the manner in which they are made at each station. In petrofabrics, such schemes are a function of the type and scale of the fabric element under consideration, the degrees of homogeneity and development* of the subfabric, and the purpose of the investigation. Sampling of macroscopic elements is obtained by standard field mapping techniques. Any microscopic petrofabric analysis begins with the collection of a geographically oriented specimen, i.e., one that is related to some fixed three-dimensional coordinate system. Oriented thin sections are cut from the hand specimen, so that the final results can be placed back into the geographic and geologic framework (Fig. 2). Various plans for sampling thin sections are discussed by Chayes.[17]

Poor sampling schemes can influence the observed orientation pattern for a fabric element. For example, one type of problem is the preferential sampling of a given fabric element because it is more easily measured in certain orientations than in others. If macrofractures are being measured along a road cut, for example, those fractures intersecting the long trend of the outcrop at high angles will tend to be preferentially sampled over fractures that trend more nearly parallel to the outcrop surface. Or on the microscopic level, a common bias in universal-stage work is to preferentially sample

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*The orientation pattern of any fabric element varies between two end points: randomness and total alignment. The relative strength of a fabric increases as the state of total alignment is approached; and, conversely, the relative weakness of a pattern increases as it approaches randomness.