FORUM

Comment and Reply on "Fault-related rocks: Suggestions for terminology"

COMMENT

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In suggesting a refined terminology for fault-related rocks, Wise et al. (1984) have made a noble effort to bring some order to the muddled nomenclature of metamorphic rocks associated with fault zones. I raise two questions for further discussion. First, why are cataclasites and mylonites separated from "metamorphic rocks" in Figure 1 of Wise et al. (1984)? Cataclasites and mylonites *are* metamorphic rocks. Figure 1 suggests that they are not.

The second question relates to a particular group of fault rocks, commonly encountered in the field, that do not seem to fit into the nomenclature scheme of Wise et al. (1984). These rocks are foliated, friable rocks typified by slickensided fragments. Such rocks, which also characterize some mud-matrix and serpentinite-matrix melanges, are found along sections of the Tesla-Ortigalita and Lone Tree faults in the Diablo Range of California (Raymond, 1969, 1973). Similar appearing, but in part more coherent rocks, occur along parts of the San Andreas and Calaveras fault zones in California and the Brevard zone near Rosman, North Carolina (Hatcher et al., 1979).

Do the rocks in question fit the classification of Wise et al. (1984)? Inasmuch as these rocks have a fabric but can be removed from the outcrop and crumbled easily with a bare hand, I would describe them as foliated, noncoherent rocks. If they are foliated, they must be mylonites under the proposed classification scheme; yet the definition of mylonite specifies coherency. Thus, this not uncommon fault rock type seems to be excluded from the classification scheme. Either the term coherent should be eliminated from the definition of mylonite or the definition for cataclasite should be expanded to include foliated rocks. I prefer the latter.

REPLY

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Regarding Raymond's Comment, mylonites are unquestionably metamorphic rocks, albeit atypical ones. This distinction with respect to common metamorphic rocks was implied throughout our text (Wise et al., 1984). In addition, Figure 1 of our article tries to underscore the normal nature of the common rocks by placing the phrase "gneiss, schist, etc." next to the words "metamorphic rock."

We disagree with Raymond's suggestion of including possible metamorphic foliation in our category of "cataclasites." The classification was designed to follow common usage in excluding such cataclastic products as breccia and gouge from the category of "metamorphic rocks." Instead, one might recognize that some fault zones can be active within metamorphic areas and/or induce metamorphic conditions (pressure, fluids, elevated temperature, flow deformation, et.) within the zone. Consequently, typical foliated metamorphic rocks can be produced as local features in or near fault zones. If other characteristic fault features are absent, we believe these rocks should be given their common metamorphic rock names. Younger or sporadic fault motions operating on these foliated rocks can produce cataclastic (or mylonitic) overprints of the type Raymond describes.

We also recognize that for decades, these rock suites associated with tectonic melanges have borne names like "argille scagliose" or "schistes lustres." We would prefer to describe the cataclastic rocks derived from such parentage as "slickensided phyllites" or "cataclasized slates" or "brecciated schists," etc. The presence of metamorphic foliation in the parent rock does not make us regard the faulted product as either a mylonite or cataclasite.

The rationale of our classification is to maintain a clear distinction between process (cataclastic or mylonitic) and the parent rock upon which it acts. In our proposed classification, the presence or absence of foliation is merely a field guide. The fundamental distinction in the classification continues to be *rocks bearing the name mylonite must show evidence of syntectonic crystal-plastic processes.*

Raymond might have raised a more fundamental question about metamorphic conditions and our Figure 1. The boundary between seismic and aseismic slip is suggested as passing through protomylonites and some orthomylonites. For modest depths and pressures, this is probably a reasonable interpretation. For greater depths and pressures, it seems possible that an ultramylonite might be produced during a seismic event. Accordingly, the boundary might be extended to include some seismic slip in the field of ultramylonites.

The same criterion of nonfoliation for cataclasites has also been criticized by Chester et al. (1985) on grounds that compositionally banded or "foliated" gouge can be found along the San Andreas system and can be produced in the laboratory. In the narrowest sense of definitions, they are correct: compositional banding is indeed a form of foliation and such banding can be generated during macroscopically ductile but microscopically brittle flow. It certainly is not the syntectonic, crystal-plastic-produced foliation implied in our text and classification. As stated above, *the distinction between non-metamorphic cataclasites and metamorphic mylonites is fundamental to the proposed classification.*

Chester and others violate this distinction in their futher suggestion of a "nongenetic" definition of "mylonite." This definition would lump fault-produced rocks that show banding, foliation, or fluxion structure into a single category of "mylonite," regardless of whether the structure was produced by cataclastic processes or syntectonic, crystal-plastic processes. We strongly disagree with this. It seems an ill-advised idea, involving indiscriminate mixing of metamorphic and nonmetamorphic features, processes, and terminology. It ignores the findings of the last decade which have defined the crystal-plastic origins of mylonitic fabric, and it seems to be a step back toward the roots of the mylonite muddle that forced us to propose the simplified classification.

COMBINED REFERENCES CITED

Chester, F.M., Friedman, M., and Logan, J.M., 1985, Foliated cataclasites: Tectonophysics (in press).

Hatcher, R.D., Butler, J.R., Benedict, G.L., Harris, L.D., Merschat, C.E., Milici, R.C., Walker, K.R., and Wiener, L.S., 1979, Guidebook for Southern Appalachian Field Trip in the Carolinas, Tennessee, and northeastern Georgia: International Geological Correlation Program, Project 27, 117 p.

Raymond, L.A., 1969, The stratigraphy and structural geology of the northern Lone Tree Creek and southern Tracy quadrangles, California [M.S. thesis]: San Jose, California, San Jose State College, 143 p.

Raymond, L.A., 1973, Tesla-Ortigalita fault, Coast Range thrust fault, and Franciscan metamorphism, northeastern Diablo Range, California: Geological Society of America Bulletin, v. 84, p. 3547–3562.

Wise, D.U., Dunn, D.E., Engelder, J.T., Geiser, P.A., Hatcher, R.D., Kish, S.A., Odom, A.L., and Schamel, S., 1984, Fault-related rocks: Suggestions for terminology: Geology, v. 12, p. 391–394.