because of insufficient rock strengths, high tectonic overpressures–including "gas overpressures"–seem to be unattainable under geologically reasonable conditions.) Provisionally accepting the pressures quoted above as lithostatic, how could such unusual P-T conditions have been generated?

The Franciscan tectonic model I have presented (Ernst, 1965, p. 905-910; 1970, p. 892-898; 1971, p. 103-104) involves two stages of motion: (1) active Late Mesozoic subduction of Franciscan units deposited on the Pacific lithospheric plate, thought to have been encroached upon and descending under the North American plate; then (2) buoyant upward rise of the decoupled ensimatic prism. Metamorphism was postulated to have attended chiefly the first stage and would have been of the high-pressure, low-temperature variety judging from geothermal calculations by several workers. When underflow ceased, or at least diminished, diapiric upwelling of the subducted, recrystallized mélange would be expected because of the marked density contrast between the Franciscan and the mantle material it had displaced; evidence of this inferred motion is displayed in the nearly vertical western limb of the asymmetric Great Valley synclinorium—the section of strata thought to have marked the Late Mesozoic margin of the North American plate.

Gresens (1969, p. 99-105; 1971) has proposed an alternative scheme for the production of blueschists which does not require the high pressures stated above. He postulates that during the serpentinization of peridotite, the generation of reducing fluids would allow the recrystallization of the country rock to produce the observed paragenesis metastably by an admittedly little understood process. Field evidence for a genetic association between glaucophane schists and serpentinites is lacking in the Franciscan terrane because of postmetamorphic structural disruption according to Gresens. Support for his petrogenetic hypothesis therefore seems to rest entirely on the well-known global association of blueschists with alpine-type ultramafics.

I too recognize this nearly world-wide association (Ernst, 1963, p. 1; 1965, p. 905, 1971, p. 83; Ernst and others, 1970, p. 13, 83, 225) but have interpreted it as a consequence of the tectonic setting of these metamorphic belts at old convergent lithospheric plate sutures. Blueschist terranes seem to be virtually confined to subducted slabs and to have been overridden at one stage by the upper lithospheric plates (crust + mantle). In California, Japan, and the Alps, for example, the progressive metamorphic sequences developed in the so-called high pressure terranes may testify to the direction of subduction. (Inasmuch as in general the highest grade portions of these belts are situated directly below the sutures with the overlying lithospheric plates, they have been described by some workers as "inverted" metamorphic zones; however, although complex in detail, including internal thrust contacts, what is evident from most published maps is an overall lateral gradation in metamorphic zonation.)

[Reprinted from AMERICAN JOURNAL OF SCIENCE, VOL. 271, OCTOBER, 1971]

Clearly, various interpretations can be made of the blueschist-serpentinite-plate junction association; therefore, it seems to me that Gresens' hypothesis for the production of blueschists, which appears to be based solely on the observed restriction of the glaucophane schist suite to alpine-type ultramafic belts, requires additional documentation.

REFERENCES

Ernst, W. G., 1963, Petrogenesis of glaucophane schists: Jour. Petrology, v. 4, p. 1-30.

——— 1965, Mineral parageneses in Franciscan metamorphic rocks, Panoche Pass, California: Geol. Soc. America Bull., v. 76, p. 879-914.

——— 1970, Tectonic contact between the Franciscan mélange and the Great Valley sequence, crustal expression of a Late Mesozoic Benioff zone: Jour. Geophys. Research, v. 75, p. 886-901.

——— 1971, Do mineral parageneses reflect unusually high-pressure conditions of Franciscan metamorphism?: Am. Jour. Sci., v. 270, p. 81-108.

Ernst, W. G., Seki, Y., Onuki, H., and Gilbert, M. C., 1970, Comparative study of low grade metamorphism in the California Coast Ranges and the Outer Metamorphic Belt of Japan: Geol. Soc. America Mem. 124, 276 p.

Gresens, R. L., 1969, Blueschist alteration during serpentinization: Contr. Mineralogy and Petrology, v. 24, p. 93-113.

——— 1971, Do mineral parageneses reflect unusually high-pressure conditions of Franciscan metamorphism? Discussion: Am. Jour. Sci., v. 271, p ????