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Formation of Red Beds in Modern and Ancient Deserts: Reply

Thermodynamic data such as those cited by R. F. Schmalz are not proofs of naturally occurring reactions, and their validity should be considered in light of available geologic evidence. Geologic evidence in the Baja California red beds (Walker, 1967a, p. 360–361) indicates that a yellowish iron oxide which is amorphous to X-rays, and which I have referred to as limonite, forms from intrastratal alteration of iron-bearing grains and converts to hematite upon aging. The reaction path by which the conversion takes place is not known; however, since there is no X-ray evidence that goethite is present as an intermediate phase, the conversion apparently is directly from the yellow precursor to hematite.

Under naturally occurring conditions the yellow precursor apparently can age either to goethite or hematite, depending on physical-chemical conditions which at present are not understood. Small variations in interstitial temperature, pressure, the presence of other ions, and other unknown factors probably play important roles in determining which of the two mineral phases will be stable.

Whether or not the conversion of the yellow precursor to hematite takes place beneath the water table is a debatable point, and I do not claim to have demonstrated that it does. The evidence I have presented in my article, however, indicates that it may, and further investigation of the conditions that might cause the conversion, in my opinion, seems warranted. A simple bit of field evidence which indicates that hematite forms in the presence of water is its common occurrence at depths of several feet below the ground surface in red soils of continuously moist tropical regions. This hematite is formed in a micro-environment that is water-saturated at all times owing to films of hygroscopic and pellicular water which in moist climates are not removed from the soil by either surface evaporation or transpiration through plants. By analogy, it is likely that, given enough time and suitable physical-chemical conditions, hematite will also form in the saturated zone beneath the water table.

Schmalz contends that tropical savanna climates are ideal environments in which to form red beds, but he does not support this contention with convincing evidence. He would greatly aid his argument and at the same time make a very significant contribution to red bed literature if he would document an example of red beds that are forming today under these climatic conditions. It is apparent from his comments that his interpretations are influenced by Krynine's published descriptions of modern sedimentation in southern Mexico (1950). Schmalz is not aware that Krynine did not accurately portray the modern sediments in Mexico (Walker, 1967b), and that, contrary to Krynine's claim, red beds are not forming there today. I have been very concerned about the effect of climate on red bed formation, and during the the two years since the manuscript of my article was written I have expanded my investigation into tropical regions in order to make comparisons with deserts. I have examined the Mexican localities described by Krynine and all other regions in Mexico that receive more than 40 inches of rainfall annually. I also have examined tropical savanna regions throughout the Orinoco basin in Venezuela. Red soils occur sporadically in all these regions, but I have found no evidence in any of them of red beds forming in the manner described by Schmalz. On the basis of this experience I question his claim that savanna climates are ideally suited for the formation of red beds.

In summary, nothing in Schmalz's discussion alters any of the conclusions stated in my paper.

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References Cited

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