LETTERS

Aboriginal Cultures and Earth Science

Gary Huckleberry's comments (*GSA Today*, April 1999, p. 14) on the Indigenous Earth Sciences Project (IESP; Riggs and Marsh, 1998) offer caution to the uninformed. However, as a tribal-college geologist and a participant in the two IESP conferences thus far concluded, I can assure him that the distinction between empirical and revealed knowledge is not lost on us. We are interested in diverse means of earth study, but we don't propose to "mix science and religion."

Ethnobotany, ethnomathematics, and archaeo- and ethnoastronomy have shown that aboriginal cultures contain a wealth of scientific knowledge of their natural environments (e.g., Williamson and Farrer, 1992). To these established sciences, my colleagues and I, who include Native Americans and non-Natives, propose to add ethnogeology: study of the indigenous, empirical geological knowledge and practices of extant ethnic groups.

Our work is an adjunct to a broad synthesis of ethnography and pedagogy underway at some tribally controlled schools and affiliated institutions. The intent is to enhance K–16 curricula by appropriate integration of traditional knowledge into all subjects. Such knowledge can be brought into the mainstream when it is culturally and epistemologically appropriate (Semken, 1997). More indigenous and Western-trained scholars are needed—a strong impetus for collaborations such as IESP.

Strictly ethnogeological works are still few (see the March 1997 *Journal of Geoscience Education* for examples). Native science is place-centered, and will always be most valuable to the nations whence it comes. If it extends no further, the effort is still worthwhile because cultural connectedness enhances minority-student interest in science (Ridgway et al., 1996). However, many ethnoscientific ideas, such as those dealing with environmental management, might be applied globally.

Studies of Native geoscience have attracted support from DOE (environmental restoration), NASA (effects of climate change on Native homelands), and the USGS and NSF (science education). The Navajo Nation Division of Education and my college have placed integration of ethnoscience at the core of an NSF Rural Systemic Initiative to improve regional science and math education.

We don't know if ethnogeology will prove as fruitful as its predecessors in the life and space sciences. But surely it is wrong to preempt study and discourse with an assertion that Native Americans, living for millennia as close to geological phenomena as anyone can, have only geomythology.

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Grand Canyon Redux

The article in the April 1999 issue of *GSA Today* by Ivo Lucchitta and Luna B. Leopold fails to provide a timely, innovative, or balanced report about floods and sandbars in the Grand Canyon. They proposed that controlled-flood releases from Glen Canyon Dam be timed with natural floods of the sediment-rich Little Colorado River to replenish sandbars in the Grand Canyon reach of the Colorado River. Their proposal is not new; it was discussed for years by scientists of the Glen Canyon Environmental Studies and was published in 1995 (ref. 1). Moreover, the Grand Canyon reach is not sediment deficient (ref. 2), as Lucchitta and Leopold claimed. The sediment supply is critically short, however, in Glen and Marble Canyons upstream of the Little Colorado River; the proposed flood would only exacerbate this deficiency.

Balance is lacking in the section "The Recent Geologic Past," where Lucchitta and Leopold presented their version of Holocene alluvial chronology of the Colorado River and described a possible correlation between pre-dam flood stages and terrace levels. As primary sources, they cited Lucchitta et al. (1995), "Lucchitta and colleagues," and "Lucchitta et al., USGS data." However, a substantially different Holocene chronology and relation of flood stage to terrace sequence was published (ref. 3) before the Lucchitta et al. 1995 paper. This work was the basis of three additional publications (ref. 4); Lucchitta and Leopold cited none of these. Considering only one difference, our results show that latest Holocene alluvium is widespread. Therefore, this time was largely aggradational, not strongly erosional as Lucchitta and Leopold inferred.

Readers interested in a more complete rendition of the flood stage, terrace sequence, and alluvial chronology stories should consult all the pertinent papers and then judge the various interpretations. Timely information about ongoing sandbar research is available at several Web sites (ref. 5).

References Cited

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Letters *continued on p. 19*