



# Focal Points

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## Special Issue: the Award for Research and Creative Activity

Research and creative activity is celebrated in the College of Arts & Sciences through a newly-established faculty award. The award recognizes a significant research publication or creative project appearing during the previous two years and receiving expert critical review at the regional (i.e., multi-state), national, or international level. A faculty committee, chaired by the Associate Dean, selects the annual recipient, and in this inaugural year of the award, the winner is **Professor Hugh H. Mills**, Department of Earth Sciences. In the following essay, Professor Mills describes the research upon which the award was based.

Jack Armistead, Dean

### **"Relative-age dating of transported regolith and application to study of landform evolution in the Appalachians"**

This paper was presented at the Weathering and Landscape Evolution, 35<sup>th</sup> Annual Binghamton Geomorphology Symposium, held in Lexington, KY, Oct. 2, 2004. The paper was published in the journal *Geomorphology*, 67, (2004): 63-96.

My field of geology is geomorphology, the study of landforms and the processes that shape them. Generally geomorphology is concerned with the latest of the geologic periods, the Quaternary Period, approximately the last two million years. Usually the deposits of this age are loose and unconsolidated deposits (regolith) rather than hard rock as are many deposits from older geological periods. The study of Quaternary landforms requires some way of ordering these features by age. Consider, for example, the question of whether a particular ice lobe in Wisconsin advanced at the same time as another in Minnesota advanced. Such information is essential for working out the history of the ice sheets that covered North America during the Quaternary ice ages. Ideally this would be done by obtaining numerical dating, utilizing radiocarbon and other methods that produce ages in years, which would allow the temporal correlation of the ice lobes to be tested. However, many deposits simply cannot be numerically dated. Deposits lacking organic material, for example, cannot be dated by the radiocarbon technique.



Such difficulties led to the idea of relative-age dating as an alternative means of correlating Quaternary deposits. As an analogy, suppose we were trying to sort a group of people by age without knowing their birth years. We might place them in approximate order of age by how wrinkled their faces are, with the most wrinkled being the oldest. We might even quantitate this approach by counting wrinkles. In favorable circumstances, relative-age dating might even be used to determine actual ages. If we knew the actual ages for a few people, we could compute a regression equation between degree of wrinkling and age. Then we could use the number of wrinkles to estimate actual age for the rest of the people.



Turning to the geological realm, when soils and rocks are exposed to the atmosphere, over long intervals of time they are gradually changed by weathering. Just as a log decays and oxidizes over time, an analogous process affects soils and stones, albeit at a much slower rate. For example, in a well-drained setting in a humid climate, soils gradually become redder with time. This reddening can be quantified using visual comparison charts. Stones exposed at or near the surface may crumble with age, and their hardness may be measured. Some types of rocks develop orange weathering "rinds" (see Figure). The older the stones, the thicker the rinds. Rind thickness can be used as indicators of relative age, where rock type, climate, and other variables are held constant. Such relative-age dating techniques, although they do not provide an actual age, may be sufficient to show that two glacial deposits are approximately the same age, thus allowing the two glacial lobes discussed above, for example, to be correlated, thereby showing that the two ice lobes advanced at about the same time. As with the wrinkled faces analogy, if it is possible to actually date several deposits in an area, then it may be possible to develop a calibrated-age relationship, in which relative-age characteristics can be translated into actual ages based on these few sites. This is the ultimate goal whenever relative-age dating is carried out, but in many areas it has not been possible to do this. Although originally developed in the context of glacial deposits, relative-age dating subsequently has been extended to non-glacial deposits such as stream and hillslope deposits. In the Appalachian region, readily applied chronometric methods that produce actual ages have proved difficult to find, so that relative-age dating has been particularly important in this region. In my paper I have tabulated and analyzed the results of these dating techniques, both those used by myself and those used by others.

In addition, I have discussed examples of how relative-age dating has shed light on the evolution of Appalachian landforms in several types of environments, with the majority of the examples coming from my own research. For example, I showed that in wide areas of the Valley and Ridge, old stream deposits are much more widespread than younger ones. Alluvial fans in the Blue Ridge Mountains show patterns of surface age that demonstrate a development sequence not previously described for fans. On hillslopes near the glacier border, red (old) colluvium (hillslope deposits) rarely appears at the surface but rather is generally buried by brown (young) colluvium probably generated by deep freezing during the ice ages, whereas in the southern Appalachians red colluvium is common at the surface.

Dr. Hugh H. Mills  
Earth Sciences



Weathering rinds on amphibolite stones in northwestern North Carolina. Rock hammer handle is 1 inch wide.

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Editor, Jack Armistead, Dean  
Editorial Assistant, Glenda Pharris

College Staff  
Paul Semmes, Associate Dean  
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Susan Maddux, Coordinator of General Education Events

College of Arts and Sciences  
Tennessee Technological University  
Box 5065  
Cookeville, TN 38505-0001  
(931) 372-3119  
Fax: (931) 372-6142  
e-mail: [FocalPoints@tntech.edu](mailto:FocalPoints@tntech.edu)

