The Absolute Dating of Desert Varnish Likely Inaccurate

Desert varnish, also called rock varnish, is a mineral coating commonly found on rocks in semi-arid and arid environments. It is a thin layer less than half a millimetre thick and consists of about 70 per cent clay minerals, 20 to 30 per cent oxides of manganese and iron, and trace amounts of over 30 other compounds. Desert varnish is normally black due to the presence of manganese, but can be orange in varieties with little manganese and a large proportion of iron. The origin of desert varnish is not completely known, but it is believed to be a result of either bacterial action, physico-chemical precipitation, or both.[13]

Geologists noticed that desert varnish generally becomes darker, thicker and covers more of the rock with age. So, it can be a relative dating method. Upon further analysis it was discovered that cations of several of the trace elements in the varnish supposedly decreased with time. An 'absolute' dating method was then constructed in which the ratio (K + Ca)/ Ti decreases with age, presumably due to leaching of potassium and calcium (see Figure 1). However, the cation ratio had to be 'calibrated' by AMS C-14 dating of carbon in the desert varnish:

> *'To obtain actual dates from measurements of the cation ratio, we would need to calibrate the measurements against those made by some other technique, such as radiocarbon dating, for a surface of the same age as the varnish.* '[4]

Since then the cation-ratio method has dated landforms, such as glacial moraines, rock art, and archaeological artifacts. Several palaeoenvironmental deductions have also been deduced from cation-ratio dating. According to Dorn, the dating method has also been *'verified independently'* by other workers using different analysis techniques.[5] Dorn also states that cation-ratio ages have been validated by blind tests and are consistent with ages derived by other methods, such as carbon-14, chlorine-36, aluminium-26, and beryllium-10.[6] He further states that five different laboratories around the world have found decreases in the cation ratio with age. So, the cation-ratio dating method appears to be quite sound and reliable, producing dates of tens of thousands of years.

Despite the above accomplishments, the theory behind cation-ratio dating and its reliability have recently been strongly challenged (see Figure 2).[7,12] First, the supposed mechanism

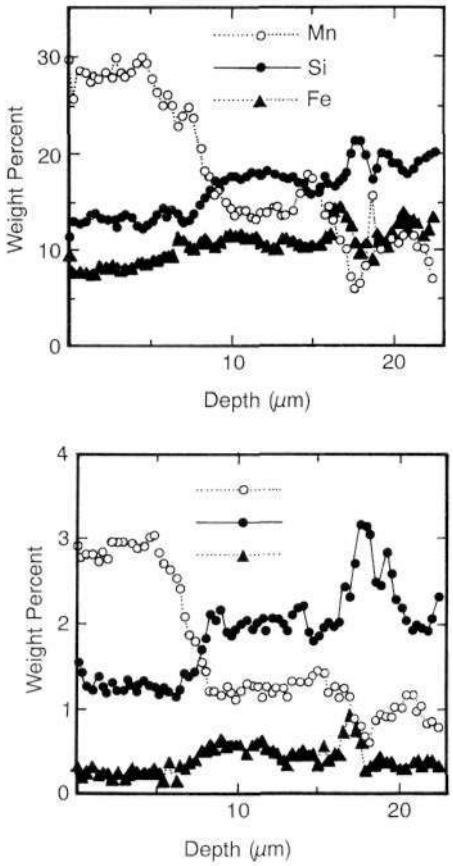

Figure 1. *Plots ofFe, Mn and Si versus depth (top) and Ca, Kand Ti versus depth for a line profile across a sample of desert varnish.*

behind cation-ratio dating — leaching of potassium and calcium from desert varnish with time — is in dispute, despite the contrary conclusions of Krinsley and Dorn.[13] Bierman and Gillespie found no change in the cation ratio with relative age.[14] Reneau and Raymond[15] believe the reason the cation ratio has been found to decrease with depth of varnish sampled is because Dorn and co-workers have measured increasing amounts of substrate, the rock underneath the varnish, within the varnish as they have analysed deeper portions of the varnish. Alternately, the decreasing ratio could be due to higher amounts of volcanic ash in the past. Volcanic ash contains a higher amount of titanium than modern desert dust.

Second, the sampling technique is highly prone to error because the chemical composition of the varnish is heterogeneous, the scraping technique is imprecise, and the varnish is composed of thin and thick zones, which make analysis difficult. Two measuring techniques were found to give significantly different values for the cation ratio.

Third, the environmental conditions might not be stable enough for long periods of time. For instance, strong winds can erode varnish by sandblasting. A new varnish coating on the surface, hence, would be younger than expected. One result from the Mojave Desert found no difference in the development of desert varnish on supposed Pleistocene surfaces versus Holocene surfaces.[16] Animals can turn over rocks or artifacts, so the varnish must start coating a bare surface. Since varnish is made up mostly of aeolian dust, this dust can vary over time in a dry environment.

Fourth, the chemical analyses may be inaccurate. The failure before 1990 to subtract a significant barium signal in measuring titanium seems to be a serious problem.

Fifth, the accuracy of the method depends upon the reliability of the calibration with carbon-14. This calibration is the reason, of course, why the derived ages are tens of thousands

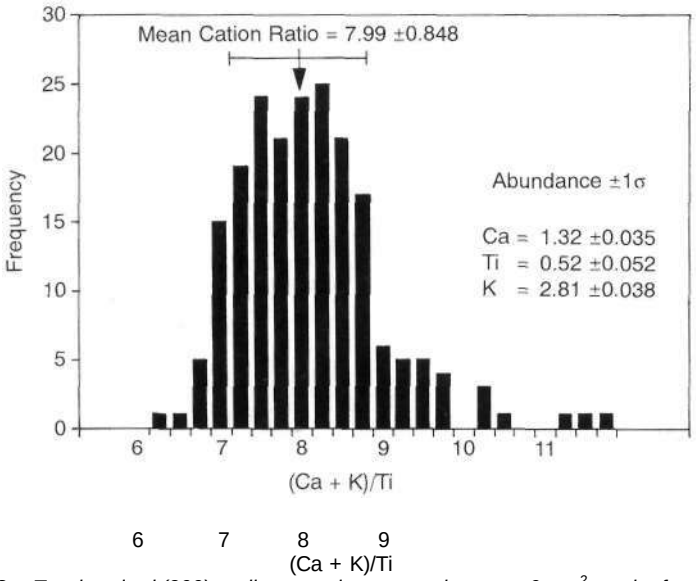

Figure 2. *Two hundred (200) replicate analyses over the same 6 mm² patch of varnish on the Bishop Tuff, California, gave a wide range of cation ratios.*

of years.

There has also been a lively exchange in the literature over the validity of the technique. In one particular exchange, Bierman and Gillespie revealed that blind tests used to substantiate cation-ratio dating were biased:

> *'Dorn's "selected examples" disregard inconsistent ages, omit pertinent information, and include circular reasoning.*[ni]

They also charge that the so-called agreement of cation-ratio ages with other dating methods is a contrived result due to data selectivity among variable dates. The cation-ratio technique was even used to calibrate the chlorine-36 dating method, which is one of the dating methods that 'agreed' with cation-ratio dates![18] The laboratory intercomparisons alluded to by Dorn are '. . . *actually two analyses of a single geological sample. . .*'[n9] **In** summary, Bierman and Gillespie conclude:

> *'We made and tested varnish-like standards because none existed and because the accuracy of both SEM and PIXE had been questioned repeatedly. . . There is now compelling evidence that cation-ratio variations are greatly influenced by sampling strategies and measurement techniques .. . Although the cation-ratio method appears to work for Dorn, we and others have been unable to reproduce his results or verify the accuracy of analyses on which his ages are based.* '[20]

Cation-ratio dating likely is inaccurate. The controversy over the validity of the technique and the manipulation of data holds a deeper significance for creationists. It adds more evidence that uniformitarian dating methods really are in large measure a 'dating game'.[21] We have much reason to be skeptical of the techniques and the derived ages.

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