Several Problems in Radiometric Dating

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ABSTRACT

In radiometric dating there are several sources of error which seem to have been given less attention than is desireable, and which are discussed in this paper. The main topics are: Indications of the effects of groundwater circulation on the loss of Ar and Sr, the zero point in K/Ar-dating and argon excess, the argon level in groundwater compared with the rate of accumulation of radiogenic argon in potassium-bearing minerals, the role of dimension in diffusion losses from minerals. Ways are pointed out to control diffusion loss in single-crystal dating by the use of minerals of the most various sizes. For Tertiary rocks the main phases of groundwater circulation may be reconstructed from geomorphological history and phases of argon loss thus inferred. In this way one may distinguish between the radiometric age of geomorphological phases and that of the modelled rocks. Here, Iceland is used as an example. In an earlier high-temperature stage in the British Tertiary basalts, the argon is similarly thought to have been lost; the fact that most dykes give ages in the same range as the lavas, is thought to support this conclusion, because the study of argon retention suggests that dykes possibly contain originally various amounts of excess argon. This leads to a general test of phases of argon loss by way of dyke ages.

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1. INDICATIONS OF THE EFFECTS OF GROUNDWATER CIRCULATION ON THE LOSS OF Ar AND Sr.

Groundwater circulation is most commonly the logical result of a hydrostatic head, which is intimately connected with topography. In addition, structure plays a decisive role in groundwater flow. It is the rule rather than the exception that normal groundwater circulation in mountainous regions goes down to such depths that the emerging water has a temperature of 50°C or more. These thermal waters have quite generally dissolved various substances, and these must have come from the minerals along the course of the flowing groundwater. Radon is a normal dissolved gas in thermal waters. In spite of some complications as to the locus of the last absorption of the radon contained in thermal waters, it can hardly be doubted that radon was also absorbed by the water along its course of the highest temperature and pressure. Besides absorption of radon, the many effects of groundwater reaching depths with temperatures of 100–150 °C include at least partial dissolution of such minerals as feldspars, to restore mineralogical equilibrium by the formation of zeolites, calcite, chlorite, and quartz. It seems hardly possible to assume that rocks of an age above 50–100 million years have escaped such effects of groundwater, because their present existence at the surface implies that they have been sheltered from denudation by a cover of younger rocks, for at least tens of millions of years. The radio-