The use of Radon in streams as a guide to Uranium distribution in south-west England (Abstract)

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Analysis of ^{222}Rn in stream waters of the Dartmoor, (Heath 1979) and Carnmenellis areas has revealed an apparently well-defined distribution pattern of ^{238}U, the initial parent of Rn. Further investigations, however, have shown the relationship between ^{238}U in rocks and ^{222}Rn in streams draining those rocks to be a complex one. Rn is not supported in solution by U or Ra and enters streams dissolved in waters draining nearby rocks and soils. The factors controlling Rn distribution appear therefore to be hydrological, and related to Rn transport, as well as geochemical and related to the presence of U.

The association of high stream Rn concentrations with Sn mineralisation within the Dartmoor and Carnmenellis granite areas is not generally observed outside the granite contacts and it appears likely that the local hydrology of mine sites within the granites is favourable to the build-up of relatively high Rn levels in streams. Waters draining mine debris consisting of fresh granite fragments with a large water-rock interface area are likely to take large amounts of Rn into solution. A Rn anomaly may thus be produced which is not related to U mineralisation.

The U mineralisation at Fingle Bridge, Lustleigh, Meavy (Bowie and others 1973) and King's Wood (Dines 1956), is found in areas underlain by Palaeozoic country rocks consisting largely of shales and slates: rocks of low permeability. Stream Rn anomalies depend not only on Rn production by decay of U in the underlying rocks but also on diffusion and transfer from the source into stream waters (Andrews and Wood 1972). As ^{222}Rn has a very short half-life (3.825 days) this migration must take place fairly rapidly and rocks of low permeability will prevent Rn escape and preclude the development of high Rn concentrations in streams. Thus, the Carboniferous sedimentary rocks to the south of Launceston contain U concentrations comparable to those of the Dartmoor granite (around 15ppm), while the streams of the area contain very little Rn. Here the rocks are dominantly pelitic and of low permeability. Similarly, known U mineralisation at South Terras (Dines 1956) is associated with only a weak Rn anomaly, rather high for the killas but similar to granite background values. As different geological environments will have different radon background characteristics these must be determined before anomalies can be identified.

An additional control of Rn in streams is indicated by the observed correlation in Dartmoor streams of Rn in the waters with U in the active stream sediment. This correlation implies a surprisingly rapid migration of Rn from the sediment to the surface waters of a stream, although a flux of water through the generally very coarse sediment would be expected. However, as this is based on only twenty sample points it is possible that a larger sample population would not show this correlation as clearly.

The use of Rn in streams as an indicator of U in the underlying rocks in an area of variable bedrock lithology and widespread mining activity such as south-west England is therefore a qualitative technique and well-developed Rn distribution patterns may not always relate directly to the distribution of the U parent element.

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Table of Contents