# THE DIGITISATION AND GEOLOGICAL INTERPRETATION OF DATA FROM THE 1957–9 AIRBORNE RADIOMETRIC SURVEY OF SOUTH-WEST ENGLAND

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An airborne radiometric survey was flown over south-west England in 1957-9 as part of the UK Atomic Energy Authority (UKAEA) uranium exploration programme. The total gamma count dataset has recently been digitised giving an overview of the region unobtainable from the original hand-contoured 1:25,000 scale maps, and providing a valuable geological and environmental resource.

The most striking features are the large hollow-centred total-count highs over the principal granite outcrops. Closer inspection reveals (i) variations related to the mineralogical type of granite, degree of kaolinisation and cover by superficial deposits; (ii) low radiometric levels over the Lizard Complex and other basic igneous rocks; (iii) changes related to major lithological divisions in the sedimentary succession; (iv) local anomalies over lamprophyric rocks; (v) high values related to uranium mineralisation peripheral to the granites; (vi) linear features, some of which are coincident with known geological structures, and (vii) anthropogenic anomalies. The latter category includes many prominent peaks (sore-thumb anomalies) that were investigated at the time and found to be caused by mining and quarrying activities.

Variation in the dataset at the regional level is largely controlled by the geology, particularly the uranium content of the rocks. It is concluded that changes in the 44 years since the survey have had little impact on the regional pattern, although the cessation of metalliferous mining and remediation activities are likely to have modified individual 'sore-thumb' anomalies. Examples show that the dataset has the potential to aid geological, environmental and epidemiological studies. It also gives a snapshot of radiation levels at a time of nuclear testing in the atmosphere and prior to the establishment of environmental controls on human activities.

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## INTRODUCTION

Stimulated by the development of nuclear technology in the 1940s, exploration for uranium was initiated by British Government agencies with the aim of identifying indigenous sources of supply. Much of the work was carried out by the Atomic Energy Division of the British Geological Survey, funded by the UKAEA. Initially this involved the assessment of areas of known uranium occurrences, but work soon moved towards exploration for new deposits, and the development of airborne radiometric scintillation counters provided a powerful new reconnaissance tool.

In 1955 the British Geological Survey began a national aeromagnetic survey of the UK, which was being flown with a terrain clearance of 305 m and a flight line spacing of 2 km. However, because of the known metalliferous mineral resources in south-west England a proposal was made to combine the aeromagnetic survey with the UKAEA uranium exploration programme, and fly a more detailed co-funded survey over this region. In 1956 a trial airborne radiometric survey was flown over 40 sq miles of the Helston–Camborne–Hayle area of Cornwall to test the AERE 1444A gamma scintillation counter, developed by the Atomic Energy Research Establishment (AERE). The trial proved successful in that at a height of 500 ft (150 m) all the anomalies known from previous ground survey work were detected, along with a few new ones. The decision was therefore taken to proceed with the full survey.

The first part of the survey, covering west and central Cornwall, was flown in 1957 with magnetic, radiometric and electromagnetic (EM) sensors. This proved successful, although the EM results were strongly affected by cultural noise and equipment failure. Surveying was continued eastwards in 1958–59 to cover the rest of Cornwall, Devon and part of Somerset with magnetic and radiometric instruments only. The principal objective of the radiometric survey was to locate potential vein-style uranium mineralisation, so all sore-thumb anomalies on the total gamma count traces were immediately followed up by ground investigations. Less attention was given to the regional picture, and the use of the data for other purposes was not considered. As the results of uranium exploration were considered confidential at this time, only a partial account of the survey, describing some of the findings from Cornwall, was published (Bowie *et al*., 1958).

With the development and application of spatial analysis software, it was decided in 1996 to digitise a portion of the radiometric data to see if useful new information could be gained from this otherwise unwieldy and little known dataset. The aim of the work was to provide the data in a more accessible form that could be integrated with other digital information to assist in a wide range of studies including: (i) metallogenic prospectivity and mineral resource investigations, (ii) regional geological and structural analyses, and (iii) environmental assessements, including natural and anthropogenic impacts, epidemiology and time-dependent changes. The trial showed the potential of the digital data to reveal significant new features not readily visible in the original analogue products so, over a period of four years, the whole dataset was converted to digital form.

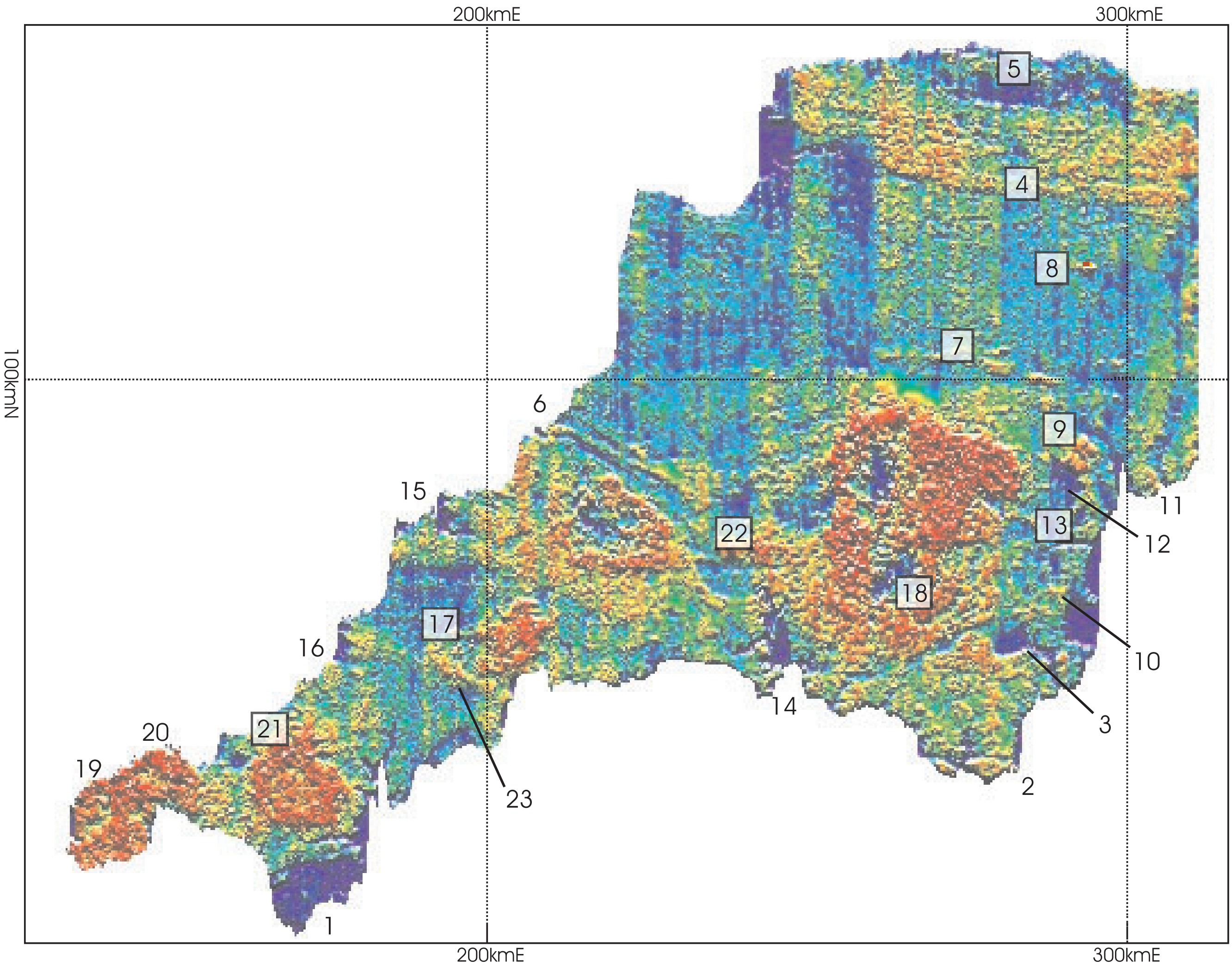


***Figure 1.** Colour shaded-relief map of radiometric data. Equal-area colour scale (red = high, blue = low). Numbers refer to features described in the text.*

## Dataset

### *Air survey parameters*

The survey area covered approximately 10,000 km$^2$ between Land's End and the National Grid line of constant easting 310 kmE. A total of 28,000 line-km was flown parallel to the north-south National Grid lines at a spacing of 400 m with a tolerance of ±200 m. The specified ground clearance was 500 ft (150 m) with a tolerance of ±100 ft (30 m). To standardise conditions on adjacent lines, flying was carried out in such a way that blocks of lines were flown in the same direction, the return flight being made down lines about 8 km away. This allowed data obtained on adjacent lines to be compared more favourably than when they are flown in opposite directions. Persistent cloud cover over Dartmoor however, meant that many of the lines in this area had to be flown in two halves (north and south of National Grid line 100 KmN) which produced local discrepancies in datum levels.

The planned flight lines were drawn onto 1:25,000 scale topographic maps that were used to navigate the aircraft, and a vertically mounted Vinten positioning camera was used to record the actual flight path. The height of the aircraft above ground was recorded continuously with a radar altimeter. Some supplementary infill flying was made in areas of particular interest and the easternmost part of the the 1957 survey was repeated by the 1958–59 survey to assist calibration and merging of the datasets. Both surveys were flown by Hunting Geophysics Ltd, using a Dakota DC3 aircraft.

### *Survey equipment*

The 1957 survey was flown with the AERE 1444A gamma scintillation counter and a new AERE 1531A instrument, which was under development. Following its successful trial, the AERE 1531A counter was used for the 1958–59 survey. This scintillation counter consisted of three detector units with a common ratemeter providing full-scale ranges and integrating times. Each detector unit comprised a thallium-activated sodium iodide crystal (118 mm in diameter and 25.4 mm thick), and a photo-multiplier. The AERE 1444A contained a single crystal of the same size and was consequently less sensitive. Technical details of these instruments and their performance can be found in Bowie *et al*. (1958).

### *Original survey records*

Results were originally plotted by the contractor onto transparent 1:25,000 scale isorad maps. Any peaks of more than three times the standard deviation of the immediate background were taken to be anomalous, and the processors inspected the flight-line traces for the main and adjacent flight lines to gauge the shape and extent of the anomaly. All anomalies that seemed to be significant were then corrected for height variations by studying the corresponding portion of the altimeter records and applying an empirical correction for air absorption. Peaks in traces due to temporary lowering of altitude were thus eliminated,

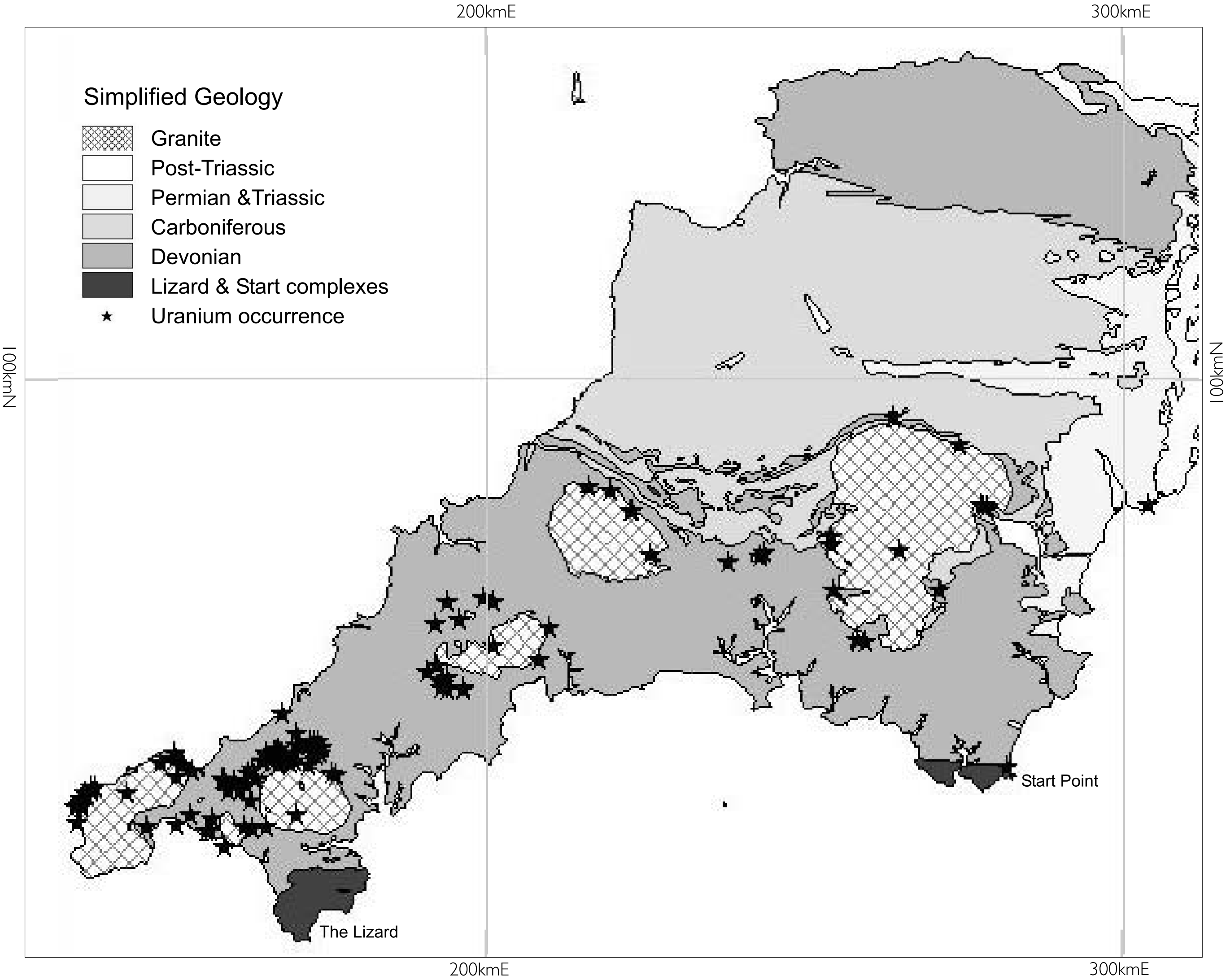


***Figure 2.*** *Simplified geological map of south-west England with locations of the principal uranium occurrences.*

but elsewhere elevation corrections were not made.

BGS holds the hand-contoured maps made from the AERE 1444A and 1531A output, and also the flight-line traces from the AERE 1444A counter and from the 1958–59 AERE 1531A survey.

## *Digitisation*

The 1957 survey was digitised from the original flight line records to see if any features had been missed in the original processing. The work involved digitising the flight line positions from the original maps, and the paper traces from the scintillation counter and altimeter records, so corrections could be made for atmospheric attenuation for the whole survey. The results showed reasonable correlation with the original contractor's isorad maps, so the 1958–59 survey results were digitised from these maps. The two digital datasets were matched and merged using statistical analysis of the gridded data and the area of overlap between the two surveys (Kimbell *et al*., 2000).

## *Results*

An image made from the resulting dataset is presented in Figure 1. This represents gamma radiation from near surface features (within 30 cm), as self-absorption of gamma flux reduces radiation from depths greater than this to negligible proportions. A number of other factors affect the gamma flux measured by the aircraft sensors, including absorption and scattering by the air, which is affected by the terrain clearance, flying speed, instrumental lag time, climatic conditions, cosmic radiation and atmospheric contamination. The latter is likely to have been accentuated by atmospheric nuclear testing and, although not mentioned by Bowie *et al*. (1958), it is known that impacts on the total gamma counts were noted at the time of the survey. To minimise variation from these sources each flight line was started and/or ended over the sea, where a zero background could be set. A radiometric control line was also established across the whole survey area along which relevant sections were re-flown at the beginning and end of each sortie. However, the presence of appreciable north-south corrugation (striping) visible over most of the survey area testifies to the limited success of these methods. Bowie *et al*. (1958) indicated that ground clearance variation had proved to be a particular problem when it came to the definition of anomalies. The topography over much of central Devon in particular is dominated by east–west trending ridges and these will have accentuated differences related to both facing and ground clearance, and it is probable that sharply rising ground with thin superficial cover facing the aircraft will have enhanced the gamma count in most places.

# Principal radiometric features

The plots of the radiometric survey data were examined principally in the light of the solid geology, major structures and superficial deposits at a regional scale. For comparison with the radiometric data, a simplified geological map of the region including locations of the principal uranium occurrences is provided in Figure 2. Summaries of the geology, structure and mineralisation of the survey area are widely available (e.g. Edmonds *et al*., 1975; Stone and Exley, 1986; Alderton, 1993) but, except for the igneous lithologies, information on the concentration of naturally-occurring radioactive elements in the rocks is sparse. A broad overview of natural uranium levels in the rocks of Britain was provided by Plant *et al*. (1983) and, more recently, published information on the uranium content of the major rock groups was reviewed by Ball and Miles (1993). Details of the many individual uranium occurrences are given by James (1947), Rumbold (1954), Dines (1956), Bowie *et al*. (1973) and Ball *et al*. (1982)

The most striking features of the total gamma plot for the whole region (Figure 1) are: (i) the large hollow-centred ('doughnut' shaped) highs related to the outcrop of the granitic plutons and associated mineralisation, (ii) the belt of moderately high values largely coincident with the Upper Devonian outcrop in North Devon, and (iii) the north-south striping artificially produced by variation between flight lines. Pronounced lows occur over: the Lizard Complex, other extensive outcrops of basic igneous rocks, a few sandstone-dominated sequences and some superficial deposits and estuaries.

## The Lizard and Start Point

The Lizard is characterised by very low radiometric values (see 1 on Figure 1), in part due to the dominant basic and ultrabasic rocks, but accentuated by superficial deposits that appear to mask the gamma flux from rocks such as the acid gneisses that are known to contain higher levels of radioactive elements (Sandeman *et al.*, 2000). In contrast, the rocks of Start Point produce a radiometric high (see 2 on Figure 1) with a distinct break, probably accentuated by the presence of hornblende schists, evident along the line of the fault which separates them from the Devonian (Meadfoot Group) succession. The Start Point rocks are dominated by mica schists whose radiometric response is probably enhanced by their topographic prominence with respect to the flight lines.

## Devonian

The radiometric data presents a rather noisy picture over the Devonian outcrop of Cornwall and south Devon. This pattern is influenced by intrusions and associated uranium-bearing mineralisation, but is also reflecting contrasting lithologies within the succession. In general, the sandstone-rich parts of the succession show low gamma activity, while the Middle and Late Devonian slates flanking the southern part of the Dartmoor Granite appear to be characterised by relatively high radiometric levels, as do the Middle Devonian strata to the south and west of Bodmin Moor. In contrast, outcrops of basic igneous rock are characterised by low values and these help to locally pick out the regional strike on the radiometric plots. The Ashprington volcanic rocks to the south-west of Torbay are clearly distinguishable as an area of uniform low values (Figure 1, locality 3). In contrast, lamprophyric minor intrusions into the Devonian succession near Truro are the source of some high values that reflect their significant radioactive element content (up to 31 ppm U and 150 ppm Th; Cooper, 1976b).

In North Devon radiometric variation related to lithological units is very clear, with high values dominating the outcrop of the Upper/Middle Devonian (Ilfracombe Slate Formation) to the Lower Carboniferous (Pilton Shale Formation) succession. The southern boundary is particularly strongly marked despite considerable variation in batches of flight lines (Figure 1, locality 4). An east–west trending striping evident within the belt of high values is attributed to a combination of topography and lithological variation. Work following the original survey related individual anomalies in this area to outcrops of the Ilfracombe Slate and Pickwell Down Sandstone Formation. Later work on heavy mineral concentrates from stream sediments indicated the presence of nodular monazite within this succession that may, if sufficiently concentrated into specific horizons, enhance the radiometric response (Read *et al*., 1987). A strong contrast is provided by low values along and inland from the north coast related to the outcrop of the Middle Devonian Hangman Sandstone Formation, while a thin east–west trending line of higher values inland from the north coast (Figure 1, locality 5) is likely to be caused by the Lower/Middle Devonian Lynton Formation.

## Carboniferous

The Early Carboniferous strata of south Devon and Cornwall are of limited thickness and outcrop along a belt from Boscastle on the north Cornwall coast, which passes eastwards towards Holsworthy, and swings northwards around the Dartmoor Granite into the middle Teign Valley (Figure 2). The radiometric survey shows some patchy enhancement over these rocks, reflecting the presence of dark shales and chert sequences which are known locally to contain some of the highest uranium levels (5–21 ppm) in the sedimentary succession (Ball and Miles, 1993). Exposures of these rocks generate small local anomalies on the north side of Dartmoor and Bodmin Moor. In contrast, spilitic igneous rocks within this succession and the underlying Devonian beds are responsible for low values which pick out the regional strike to the north of the Bodmin Moor Granite, due to the contrast with the more radioactive shale units (Figure 1, locality 6).

The Namurian and Westphalian succession of folded shales with interbedded sandstones show generally low radiometric values. In general, levels over the Bude Formation appear to be lower than over the Crackington Formation, reflecting the higher sandstone content of the former. There is slight enhancement of values over the shale-dominated area to the north of the Dartmoor Granite and to the north and east of Bude. Certain shale outcrops, referred to the Dowhills Beds (Namurian) at the base of the Crackington Formation, were considered to be the source of anomalies followed-up after the original survey at Bampton and South Molton.

## Permian

In general the Permian red beds show no radiometric contrast with the underlying folded and metamorphosed succession, except for a broken line of high values along the southern side of the Crediton Trough (Figure 1, locality 7). This is probably related to outcrops of the Newton St. Cyres Breccia Formation which are known to contain abundant K-feldspar, and at Neopardy, to the west of Crediton, a rhyolitic member of the Exeter Volcanic Group is present (Edwards and Scrivener, 1999). Lamprophyres of the Exeter Volcanic Group also generate local anomalies, most notably at Washfield (Figure 1, locality 8). Analysed rocks from here contain over 9% $K_2O$ and 10 ppm U (Cosgrove, 1972; Leat *et al*., 1987), sufficient to account for the radiometric features. There also seems to be some enhancement over the volcanic rock outcrops between Haldon and Exeter, probably reflecting the high potassium levels recorded in these lithologies. Enhancement of the radiometric values over the Permian outcrops to the north-east of the Haldon Hills (Figure 1, locality 9) and to a lesser extent to the north-west of Torbay (Figure 1, locality 10) are likely to be caused by the the presence of substantial volumes of granitic rock debris in the breccias. In the extreme south-east of the survey area, a small area of high values on the coast to the east of Exmouth and extensions inland to the north, following the regional strike (Figure 1, locality 11), are probably caused by uranium-bearing vanadiferous nodules in the Littleham Mudstone Formation. Analyses of the nodule bearing horizon yield 20-40 ppm U in places and although many analysed mudstone samples from this formation showed no enrichment, the recorded uranium levels are likely to be sufficient to account for the observed radiometric pattern (Bateson and Johnson, 1992; Edwards and Scrivener, 1999).

## Cretaceous and Tertiary

The Haldon Hills, largely formed of glauconitic pebbly sands and capped by flint gravels, form a prominent low on the radiometric map (Figure 1, locality 12). Their boundary against the more radioactive Permian breccias to the north-east is particularly well-defined despite the less active rocks occupying the high ground. The Oligocene clays and lignites in the Bovey Basin yield a relatively low background, but higher levels occur over alluvium along the line of the River Teign in this area (Figure 1, locality 13), perhaps caused by the presence of granitic debris. Sand, gravel and clay deposits of Tertiary age, such as on Crousa Downs (Lizard), Goss Moor and St Agnes Beacon do not generate radiometric signatures that contrast with the surrounding rocks.

### *Superficial deposits*

Peat cover produces very low total gamma counts and its presence is in part responsible for the low values over the inner parts of the Dartmoor and Bodmin Moor granites and the Lizard. Estuaries generate low values, due to the presence of water and alluvial deposits, consequently the forms of some of the major estuaries are well defined by radiometric lows, for example the Tamar above Plymouth (Figure 1, locality 14) and the Camel around Padstow (Figure 1, locality 15). The more extensive blown sand deposits also produce prominent low features, notably Penhale sands, south-west of Newquay (Figure 1, locality 16).

### *Granites and mineralisation*

As would be expected from their composition, high total gamma counts are recorded over all of the principal granite plutons. Close inspection and sub-division of the high values reveals considerable variation in detail. High levels are most prominent near the margins, reflecting thinner superficial deposits, the concentric structure of the earlier plutons (Stone, 2000), and the increasing levels of uraninite towards the margins of the intrusions reported by Ball *et al*. (1982). Some high values marginal to the granites may be caused by radon-rich springs, notably on the eastern side of the Bodmin Moor Granite and on the southern side of the St. Austell Granite (Cooper, 1976). High levels are particularly prominent over the eastern parts of the Dartmoor and St. Austell granites indicating the radiogenic nature of the coarse-grained potassium-feldspar-rich biotite granites which crop out in these districts. The relatively lower levels over southern Dartmoor coincide with the presence of non megacrystic, biotite-muscovite granites. Areas of intense kaolinisation and china clay working, such as the western part of the St. Austell Granite (Figure 1, locality 17) and the south-west corner of the Dartmoor Granite (Figure 1, locality 18), show low values consistent with the removal of uranium during kaolinisation (Ball and Basham, 1979).

High radiometric values extend from the granite over the Devonian and Carboniferous host rocks in many places, due to uranium mineralisation in these rocks and the spread of granitic and mineralised material by human activities. Areas of known uranium mineralisation generate high values that merge with those produced by granite in the St. Just (Figure 1, locality 19) and St. Ives (Figure 1, locality 20) districts, bordering the Land's End intrusion, in the Redruth-Camborne area (Figure 1, locality 21), close to the northern margin of the Carnmenellis Granite, in the Kit Hill-Gunnislake area (Figure 1, locality 22) and at several localities around the Dartmoor Granite. Partly due to kaolinisation of the granite reducing the gamma flux, uranium mineralisation to the west of the St. Austell Granite, which includes the former South Terras Uranium Mine, forms a distinct radiometric high (Figure 1, locality 23).

### *Linear features*

A number of linear features emerge from the digital data that are particularly well seen on monotone shaded relief images (Figure 3). Even though they have been cited as a control on the distribution of uranium mineralisation, the major north-west to south-east trending wrench faults, such as the Sticklepath Fault complex (Figure 3, A) do not register strongly on any of the regional plots. However, an enigmatic major east–west trending feature (Figure 3, B-B) is quite clear. It starts near Teignmouth in the east, bisects the Dartmoor Granite and continues eastwards through Kit Hill and Gunnislake and the southern side of the Bodmin Moor Granite, reaching the west coast north of Newquay. It does not correspond to any single surface feature, but in the Dartmoor area may be related to the Holne Thrust, a low-angle south-dipping fracture which separates the Carboniferous and Devonian outcrops. South of the Bodmin Moor Granite the feature is coincident with a zone of fold-facing confrontation, that may also mark the presence of a thrust or fault (Edmonds *et al*., 1975). In the northern half of the region, many east–west trending features are caused by a combination of topography and lithology. They reflect the regional strike of Variscan fold axes in the Devonian and Carboniferous outcrop. In places weak north-westerly features, that may be caused by faulting, are also evident. The Crediton Trough (Figure 3, C) is discernible largely due to the contrasting response of some of the Permian and Carboniferous lithologies. Other easterly-trending features clearly mark the boundaries of the Lizard (Figure 3, G-G) and Start complexes (Figure 3, H-H).

South-east trending features on the northern side of the Bodmin Moor Granite (Figure 3, D) are generated largely by lithological contrasts, but two south-south-east trending features are less obviously related to contrasting lithologies. One (Figure 3, E) extends inland from Padstow, cuts the major east-west feature (Figure 3, B-B), passes close to Bodmin and then follows the boundary between Lower-Middle Devonian strata. The second, from north of Perranporth to south of St. Austell (Figure 3, F), is near-coincident with the boundary between the Gramscatho Group and the Staddon Grit and Meadfoot Group, and the Perranporth-Mevagissey line, which has long been recognised as the possible site of a major structural break (Sanderson, 1971; Dunning, 1992).

## Discussion

It is clear that the principal source of radiometric variation in the dataset at a regional scale is the surface geology. However, follow-up of individual anomalies after the original survey indicated a very different picture, with many localised but sometimes very strong radiometric features resulting from human activities. Figures given by Bowie *et al.* (1958) for follow-up results from the 1957 part of the survey indicate that about two thirds of all the individual anomalies investigated were the product of human activities. Of the remaining anomalies, nearly all were caused by natural outcrops of granitic rocks or shales, some due to a low surrounding background. Less than 2% were attributed to unworked mineralisation.

Appleton and Ball (1995), noted the close relationship between radiometric data and radon concentrations in the St. Austell area, and concluded that uranium concentration in the rocks of this area largely controlled the radiometric response, and that the contribution to radiometric variation from thorium and potassium was small. Rock analyses suggest that this statement also holds at the regional level, with most radiometric highs being attributable to rocks (or reworked material from them) enriched in uranium. Many of these rocks also contain high levels of potassium but the good regional agreement between radiometry and radon in houses (see below) indicates that uranium content is the principal source of radiometric variation.

The greatest impact of human activity at the regional scale on the data is thought to be the spread of high values away from the granite margins due to mine working and consequent activity. It is therefore possible that the ending of metalliferous mining and the remedial activities over the 44 years since this survey was completed have had some impact on the pattern of radioactivity. However, remedial activities tend to be focused on relatively small areas where particular problems have been identified, so it is predicted that the number of high-amplitude anomalies will have decreased, but that the regional picture displayed in Figure

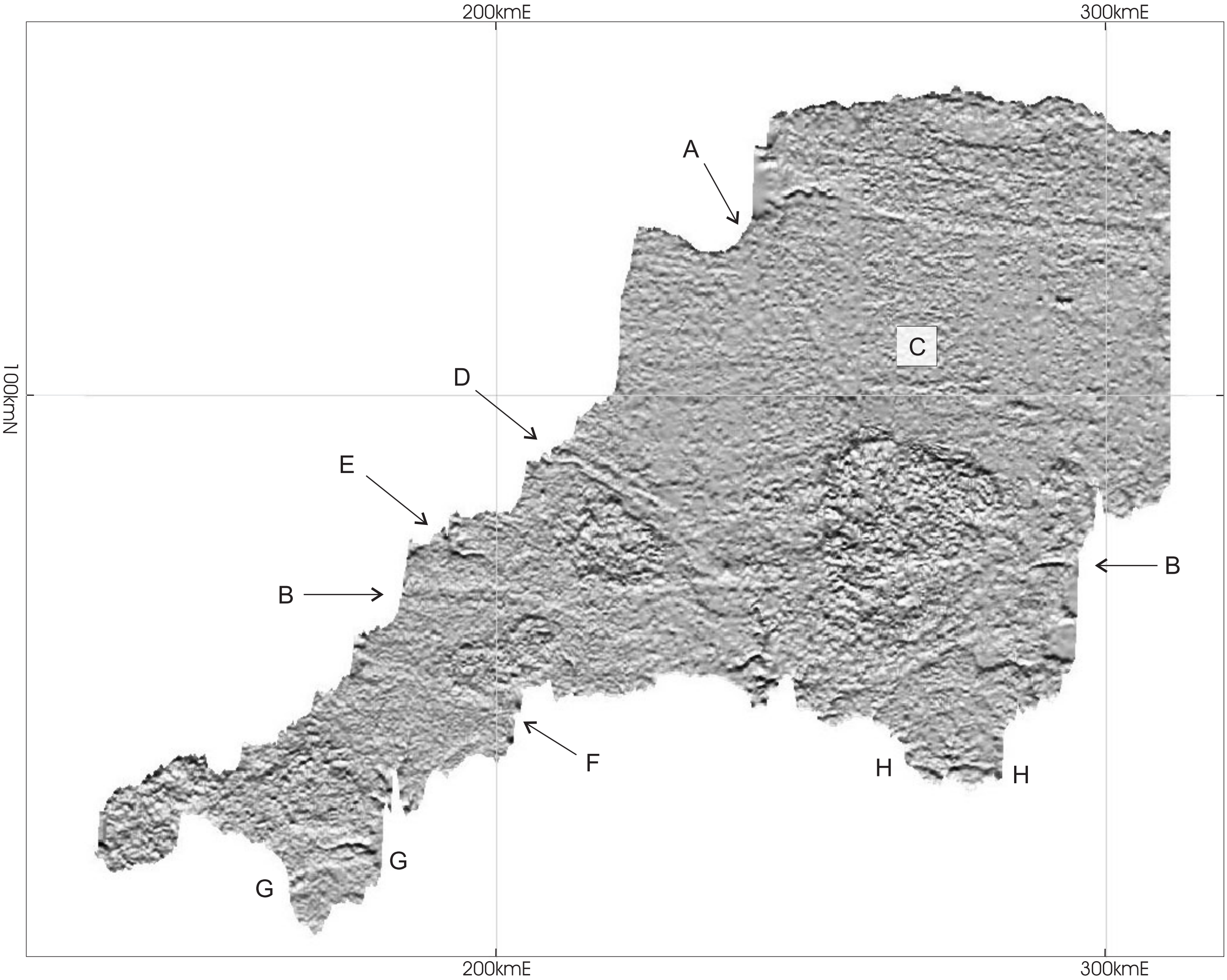


***Figure 3.*** *Shaded-relief map of radiometric data showing main structural features. Letters refer to features described in text.*

1 will not have changed.

The survey was flown at a time of nuclear weapons testing in the atmosphere, providing an additional source of variation, but measures taken at the time of the survey and during data processing to standardise background levels will have minimised any impact on the regional patterns. Unfortunately the survey pre-dated multi-channel gamma spectrometers so any specific contribution from this source to the total gamma counts and detailed comparison with any new airborne data will not be possible.

As it is believed unlikely that the regional radiometric pattern has changed greatly since the survey was completed, the dataset can be applied usefully to a range of current geological and environmentally related studies. It can be analysed with other regional datasets, such as those on radon levels in houses and geochemical variation in stream sediments and soils, to improve understanding and identify areas suitable for ground investigations. Two examples follow.

Visual comparison of the digital radiometric map with plots arising from information on radon concentrations in houses (Miles and Appleton, 2000), shows that there is generally a close correlation between areas of high measured radioactivity and areas where radon concentrations are most likely to have >5% probability of being above the level where remedial action is necessary (Appleton *et al.*, 2000). There are, however, a few notable differences that require explanation. Appleton *et al.* (2000) pointed out that in north-west Dartmoor, high airborne radiometric values do not appear to coincide with a high probability of radon concentration and suggested that this might be due to a paucity of radon data in this area due to the lack of houses. If this is so, the radiometric map allows us to suggest that if any housing were ever proposed in this area, remedial action against radon build up would be necessary. A further discrepancy was noted on the coast south of Newquay where very low radiometric values and a high radon probability appear to be near coincident. In this case the radiometric data is reflecting low values from the coastal sand dunes whilst the radon levels are probably reflecting data from just inland, where there are also higher radiometric readings. Overall, at a local level the correlation between the datasets can be expected to be poorer due to differences in the behavior of uranium and radon in the natural environment (Ball and Miles, 1993).

The radiometric dataset also has potential to add fresh insights into geological studies, particularly those related to the original survey objectives. The association of high uranium levels with black shales and low values with basic igneous rocks makes the data applicable to regional multi-dataset mineral prospectivity analysis for a range of mineral deposit types besides those containing uranium mineralisation. A recent study of this type (Rollin *et al.*, 2001) identified several areas in southwest England as prospective for stratiform massive sulphide mineralisation and the addition of the radiometric data provides a useful extra dimension to this analysis. Visual comparison of plots suggests that the relative potential for this type of mineral deposit may be increased in some of the prospective areas identified, notably the Upper Devonian succession of North Devon and the rocks close to the Devonian–Carboniferous boundary in the central part of the region.

## Conclusions

Airborne data captured in 1957–59 still provide the only radiometric coverage of the whole region. Digitisation of these data has improved their accessibility and usefulness by facilitating display at a range of scales and integration with other datasets. Digital imaging has revealed features that were not readily extractable from the original maps and enabled a regional-scale analysis of radiometric variation in south-west England. This analysis suggests that most variation in the data at a regional scale is caused by the surface geology, while many individual anomalies of limited area are at least in part related to human activities. The uranium content of the rocks appears to be a more important source of variation than either the potassium or thorium contents. It is suggested that changes over the 44 years since the survey was flown will have had little impact on the regional pattern and this allows application of the data to a wide range of contemporary studies. Notable amongst these are mineral exploration and others concerned with the impact of radioactivity on health in a region containing a wide range of gamma flux from natural sources. The data also provides a snapshot of radiation levels at a time of atmospheric nuclear testing and before most remedial work on mine dumps giving, if any new survey is flown, a unique opportunity to study changes in radioactivity across a large area over a near 50 year period.

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