GAANG

Session ***2002***

ANGLAIS

GROUPE 11

BTS GÉOLOGIE APPLIQUÉE

Durée : 2 heures *Coefficient : 2*

L'usage d'un dictionnaire bilingue est autorisé.

Avant de composer, le candidat s'assurera que le sujet comporte bien 3 pages numérotées de 1/3 à 3/3.

Traiter les deux questions suivantes :

I - REDIGER en ANGLAIS (en 300 mots, à ± 10 % près) **un compte-rendu du texte** :

« Surveying the environment from the air »

(Indiquer le nombre de mots utilisés.)

15 points

II - TRADUIRE EN FRANÇAIS, l'extrait suivant *(lignes 36 à 42)* :

Magnetometry records the magnetisation of different rock types and is used mainly to assist geological and structural mapping and in the exploration for mineral resources. However, at low flying heights many man-made metallic objects (railways, power lines, buildings, etc) give rise to so-called 'cultural anomalies'. Typically such anomalies are removed during processing because they can obscure subtle geological features. In the context of environmental studies, however, some cultural anomalies are clearly significant in their own right.

5 points

SURVEYING THE ENVIRONMENT FROM THE AIR

In late June 1999, the British Geological Survey (BGS) and the Geological Survey of Finland (Geologian Tutkimuskeskus – GTK) successfully tested an airborne survey method over four sites in the East Midlands. To our knowledge these are the first high-resolution airborne geophysical surveys flown to address specific environmental issues in the UK.

For some years GTK has successfully used its wing-tip electromagnetic system to map and monitor potential pollution hazards associated with contaminated water leaking from defective landfill sites in Finland. The main objective of the present trials was to test the effectiveness of GTK's electromagnetic system in similar applications in the generally more complex UK environment.

We targeted both active and capped landfill sites, colliery spoil heaps overlying a shallow[1] aquifer and a long-established waste lagoon. In addition to the electromagnetic survey, we also collected gamma-ray spectrometer and total field magnetic data. These additional data also have both environmental and geological significance, as explained below.

What do the different methods reveal?

Electromagnetic data provide information about the bulk resistivity[2] of the ground from a depth of a few metres below the surface to a few tens of metres. In porous rocks or soil containing water, resistivity is mainly a measure of the concentration of salts, especially those containing the highly mobile and common sodium, sulphate, chloride, potassium or nitrate ions.

Bulk resistivity can provide a distinct measure of land and water 'quality'. The resistivity measured by geophysical means cannot tell us which ions are present, but anomalously low resistivity frequently indicates the presence of more acidic or salty groundwaters, which suggests the presence of pollution. However, a further cause of low apparent resistivity is the presence of certain clay minerals. Discrimination between the two sources usually requires additional investigation.

Gamma-ray spectrometry measures the total spectrum of gamma radiation from the ground. We can identify and quantify the different components of natural radioactivity, arising from potassium, uranium and thorium. Man-made sources, such as caesium-137 arising from the Chernobyl accident, can also be measured. The depth of investigation of this technique is restricted to the top 30 cm of the land surface. The technique can provide us with information on geology where the soil is thin or is derived from the underlying parent rock. Damp conditions attenuate gamma radiation, so the data can also indicate the condition of certain soils.

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Why airborne geophysics?

The main advantages of using an aircraft for surveys are:

- simultaneous collection of data from different instruments, gathering information on a range of environmental and geological factors
- high spatial resolution, with almost continuous sampling (every 5 to 50 m) along flight lines spaced between 50 and 200 m apart
- continuous coverage over all areas, whether conurbations, landfills, forests, etc, which may be hard to sample from the ground.

It follows that airborne geophysics enjoys three major advantages over isolated 'spot' sampling techniques (such as soil or water geochemistry): high density of coverage, the synergism of integrated data sets and the additional information that can be gained on the depth and extent of possible pollutants. In addition, the geophysical techniques are non-invasive and remotely sensed, particular advantages when investigating potentially hazardous sites, although sound interpretation will require further investigation from the ground.

The surveys

The survey design was agreed in close collaboration with Mrs Maija Kurimo, the GTK party chief and geophysicist. It involved flying at low level (not more than 90 m) along a regular pattern of lines spaced between 50 m and 200 m apart, covering in total four blocks, each of between about 10 and 100 km². At two of the smaller sites we flew at two or three different levels to determine the best height for detection and also to allow a comparison between the theoretical attenuation of the signals with height and the observed attenuation.

The surveys were flown using the elegant, powerful de Havilland Twin Otter. This aircraft is owned and maintained by Finnair and operated by their subsidiary company Malmilento Oy. GTK own and operate all the geophysical equipment on board and the dual frequency electromagnetic system is their own design and build. We enjoyed relatively fine weather throughout the survey and the total 3,000 line kilometres of survey were completed in under five days.

The results are encouraging and we detected numerous conductivity anomalies. Some of these, apparently associated with landfill sites and colliery spoil heaps, may relate to pollution below the surface, but they remain to be tested by detailed follow-up surveys on the ground before we can say unambiguously what caused them.

Roger Peart

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(1) shallow : near the surface
(2) bulk resistivity : résistivité d'ensemble