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 - RÉDIGER un compte-rendu de ce texte EN ANGLAIS en 300 mots (± 10 % près).

(Indiquer le nombre de mots utilisés).

15 points

II - TRADUIRE EN FRANÇAIS, l'extrait suivant *(lignes 1 à 6)* :

"Throughout the 20th century single vertical oil wells were drilled to extract oil and gas. To exploit the reservoirs fully, a dense forest of oil drilling derricks sprang up along the shores of the Caspian Sea in Azerbaijan. Although many derricks are now derelict they still clutter the coast. Much of the wildlife has long since been destroyed and oil seeps from disused rigs. It is not a pretty sight. However, recent advances in drilling techniques have led to the drilling of a new kind of oil well – one that can turn at angles and even be almost horizontal, as opposed to going straight down."

5 points

FINE-TUNING OIL WELL NAVIGATION

Throughout the 20th century single vertical oil wells were drilled to extract oil and gas. To exploit the reservoirs fully, a dense forest of oil drilling derricks sprang up along the shores of the Caspian Sea in Azerbaijan. Although many derricks are now derelict they still clutter the coast. Much of the wildlife has long since been destroyed and oil seeps from disused rigs. It is not a pretty sight. However, recent advances in drilling techniques have led to the drilling of a new kind of oil well – one that can turn at angles and even be almost horizontal, as opposed to going straight down. This means 30 or more wells can be drilled from a single offshore platform, reducing the number of rigs required to fully exploit a particular field. But because these oil reservoirs can be far from the platform and deep within the Earth's crust, the oil companies need to be very precise in their drilling in order to make sure they hit their targets. To reach the reservoirs they have to navigate accurately underground, using tools which measure the direction of the well-bore relative to the direction of the Earth's magnetic field in the area. But anomalies in the magnetic field can throw the compass out and send the well-bore off course, perhaps missing the oil reservoirs or even hitting another well-bore. Maps of these localised changes in the magnetic field help to keep the drillers on target.

The navigators can only be as good as the maps guiding them. If the maps give the wrong values for the magnetic fields, the drill can be directed off course. To hit the increasingly small geological targets, whilst avoiding the many other wells that may be present, requires very accurate values of the local geomagnetic fields. This is where the British Geological Survey comes in.

A directional drilling company in Azerbaijan recently commissioned us to determine accurate values of the direction of the geomagnetic field at a number of drilling locations in the Caspian Sea.

The Earth's magnetic field is not constant. Its varies on timescales of a few minutes to several years, and also from place to place. Generally the time variations are small enough to be of little concern to the general map and compass user. However for precise navigation such as in directional drilling, where targets only tens of metres in size may be 10 km away and 3 km deep underground, precise information about the magnetic field is crucial.

The Earth's magnetic field originates from three sources. The main part (about 98%) is generated in the Earth's core. Each year BGS revises a model of the main field, based on observations of the strength and direction of the Earth's magnetic field made around the world. A consortium of oil companies uses this model to drill at locations around the world. The model does not account for the geomagnetic fields generated by two other sources, the rocks close to or at the Earth's surface, and the upper atmosphere. These two sources create local anomalies in the direction and intensity of the geomagnetic field, which have to be accurately quantified.

In Azerbaijan we mapped the crustal field by making direct measurements of the geomagnetic field from the land, and total intensity data from aeromagnetic surveys. We then used mathematical modelling to transform the data, so that the maps include the directions of the magnetic field caused by the crust over a wide area including the oil fields of the Caspian Sea. Such detail is the oil drilling equivalent of using an A-Z to get to a house in London rather than a road atlas.

In 1974 the Ministry of Geology of the USSR published a series of 18 total intensity anomaly maps, at 1:2,500,000 scale covering the area of the former Soviet Union. The maps were compiled from earlier aeromagnetic survey data on which there were few direct measurements of the total intensity values. In March 2001 we measured the magnetic field directly at six sites along the shores of the Caspian Sea in Azerbaijan, within the survey zone, so that the transformed aeromagnetic data could be tied to absolute values.

We carried out these measurements using extremely accurate and sensitive instruments to determine the geomagnetic field values. Plots of the transformed aeromagnetic data show that crustal field values can vary from place to place by more than the accuracy desired by the industry (0.1° in direction and 50nT in total intensity). This emphasises the importance of this study in improving the accuracy and confidence in directional drilling surveying using magnetic sensors.

Directional drilling companies who use the field values we have accurately determined with this technique can save considerable amounts of money, because they need fewer expensive gyro surveys to cross check the downhole magnetic survey data.

In areas such as Azerbaijan, where there are so many oil wells, such accurate geomagnetic data also helps the oil companies to avoid accidentally drilling into other wells. This has implications not just for safety but also for the environment.

James Carrigan, Susan Macmillan and Toby Clark.
NERC NEWS. Autumn, 2001.

Glossaire :

A-Z : plan des rues