PRELIMINARY RESULTS OF GRAVIMETRIC INVESTIGATIONS IN THE FEN AREA

BY

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Abstract The subcircular Fen complex having a diameter of 2.5 km has been investigated by gravimetric methods. The results indicate that the rocks have a pipelike downward extension and have an average density much higher than the average density of the surface rocks of the complex.

The subcircular area consists of peralkaline silicate rocks and of carbonatites which have penetrated the gneiss-granites of the Precambrian basement. The borders dip steeply or vertically. They are mainly of tectonic nature (radial and concentric faults). The rocks inside the Fen area have been investigated and described by BRØGGER (1921) and SÆTHER (1957), the dikes and breccias (see Fig. 1) in the surroundings by BERGSTØL (1959).*

In this gravity investigation, one profile along the main road from Skien in SE to Gvarv in NW has been measured with a Warden gravimeter in the autumn 1963. The methods of conducting the field work and of computing the Bouger anomalies are described by SMITHSON (1963a).

The terrain corrections are not applied to the stations, but sample calculations show that they are all within the range 0.5—1.5 mgal. The anomalies are projected normal to the regional Bouger gradient (see GRØNHAUG 1962 and SMITHSON 1963b) to a straight line Solum—Fen—Gvarv. This line is not far from parallel with the regional Bouger anomaly gradient and follows roughly the main road.

* In Geology of Norway (HOLTEDAHL 1960, pp. 99—101) a resumé of earlier work in the Fen area is given. All the authors assume the rocks to be of magmatic origin, and to have a pipelike downward continuation.

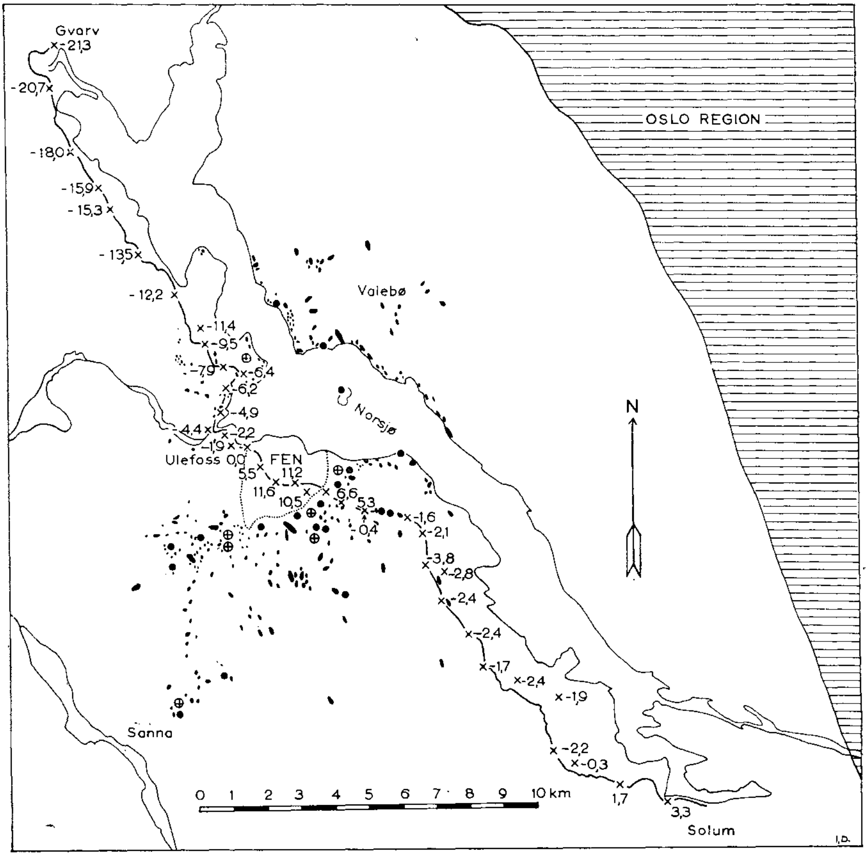

Fig. 1. Map showing the Fen explosion vent and its environment. Black dots and circles are kimberlitic and tinguaitic dikes and breccias. Circles with crosses are granitic (explosion) breccias. (After BERGSTØL, 1959). Location of the gravity profile along the main road from Solum in SE through Fen to Gvarv in NW is shown. The Bouger anomalies (without terrain corrections) are plotted.

It is apparent from Fig. 2 that the maximum anomaly along the profile is situated at the center of the Fen area and has a magnitude of +20 mgal. This shows a fairly large mass excess underground. The shape of the curve indicates that the anomalous mass, which is concentrated beneath the outcrop of the Fen rocks, probably forms a vertical cylinder. Postulating that the cylinder is 10 km deep, we can calculate the gravitational effect of the cylinder at the point where

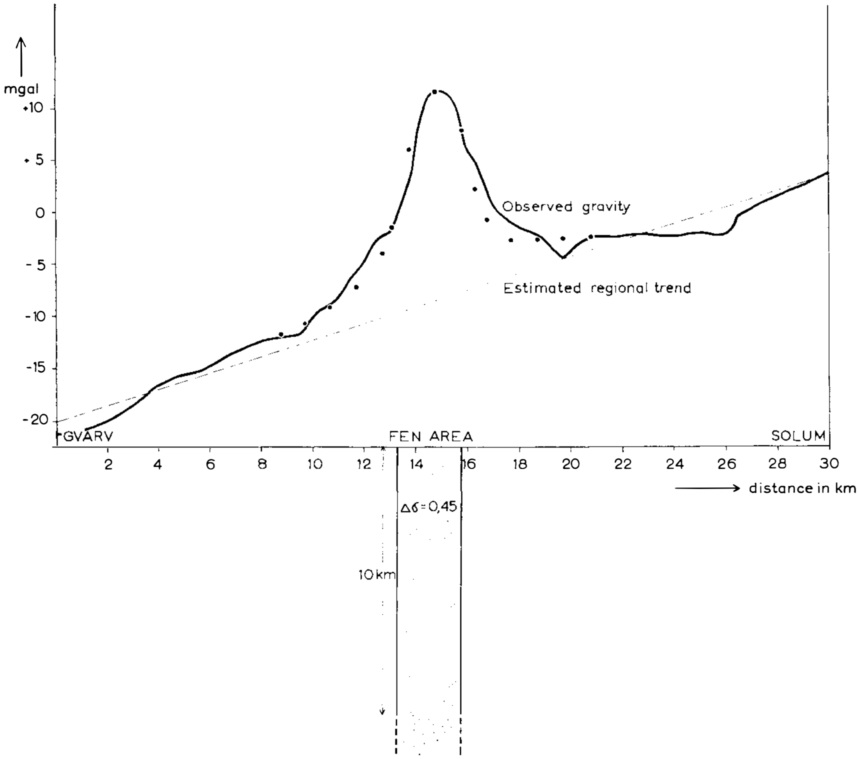

Fig. 2. The observed gravity along the profile (Solum—Gvarv). Black dots represent the gravity effect from model cylinder having a diameter equal to the Fen area, a downward extension of 10 km or more, and a density difference $\triangle\sigma = 0{,}45$.

the cylinder axis intersects the surface (DOBRIN, 1960). The density difference between the surrounding gneisses and the Fen rocks is determined to be $\triangle\sigma = 0{,}25$ g/cm³. This gives a Bouger anomaly on the axis of the cylinder of only +11,1 mgal. To obtain a large enough anomaly we have to use a density difference $\triangle\sigma = 0{,}45$ g/cm³. With this difference of density and a 10 km deep cylinder model, the gravity effects along the profile agrees fairly well with the observed anomalies (Fig. 2). If the cylinder continues deeper than 10 km the gravity effect from its deeper part will be small (DOBRIN, op. cit.), i.e. less than 0,6 mgal (for $\triangle\sigma = 0{,}45$ g/cm³). The model should therefore be interpreted as a vertical cylinder with a downward extension of 10 km or more.

If the Fen rocks form such a vertical cylinder we must draw the preliminary conclusion that the pipe consists of rocks of the density of about 3,10 g/cm³. Only damtjernite (3,08 g/cm³), vibetoite (3,18 g/cm³), both belonging to the kimberlite family, and iron ore attain the necessary density, all the carbonatites are excluded. A geomagnetic map of the Fen area (SÆTHER, 1957) shows the anomalies following the surface outcrops of the iron ore (hematite and magnetite) occurring in the carbonatites, this may indicate that the ore plays no important role in the deeper part of the pipe.

The rather surprising result of the present gravity study is, therefore, that the downward cylindrical extension of the Fen complex consists of rocks the a v e r a g e density of which is at least 3,10 g/cm³. Rocks of such type form a very small part of the present surface area.

I want to express my sincere thanks to Dr. Scott B. Smithson for having introduced me to the methods and theory of gravity investigations, and for helping me in many ways during the present work.

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