gek vezetőképessége szerint. Az elektromágneses mező irányának, erősségének és fázisának megváltozásából következtethetünk egy vagy több *elektromos felület jelenlétére* és *mélységére*. Az így nyert mélységi adatokból azután egy vagy több *elektromos felület rétegvonalas térképét* készíthetjük el, amelyek oly mértékben fogják visszatükrözni a valódi geológiai alakulatok alakját, amennyire ezen geologiai alakulatok elektromos felületeikkel *konformak*.

Bár e módszer mindjobban fejlődik és jelentős gyakorlati eredményeket is érnek el vele, a sódómok kutatásában kezdetben nem volt nagy szerepe, mivel akkor még nagyobb mélységre nem tudván e módszerrel lehatolni, mélyebben fekvő sótesteket nem is tudott kimutatni, a felszínhez közel fekvők pedig már mind ismertek voltak. Nem nagy mélységben fekvő, de már ismert sódómokon végzett elektromos próbamérések azonban szép eredményeket adtak.

Néhány éve különösen *Németországban* sótestek kutatására használják a *gravimetereket* is, amelyekkel nem a nehézségerőnek változásait, hanem közvetlenül a nehézségerő rendellenességeit mérik. Bár e *gravimeter mérések* kivitele teljesen eltér a torziós inga méréseketől, az eredmények magyarázata egészen hasonló mindkét módszernél.

PROSPECTING SALTDOMES WITH GEOPHYSICAL METHODS.

By: *Eugene Fekete.*

Geophysical methods for prospecting saltdomes were first used *in Texas and Louisiana* as early as 1923 applying the *Eötvös torsion balance* and *the refraction seismic method*. The gravity survey followed the method Eötvös used in his fieldwork while the interpretation of the torsion balance results was made according Dr. Böckh's theory, i. e. *a gravity minimum* will appear above an uplift when the core of the uplift is rocksalt and a *gravity maximum* will be obtained above such uplifts the core of which is heavier than the overlying formations.

The results of torsion balance surveys made in Germany above known saltdomes proved this theory but in Texas it was soon found that gravity maximum will appear above saltdomes lying close to the surface if a *heavy caprock* is present. The difference between the gravity maxima indicating saltdomes with caprock or uplifts is that in the first case the gradients of radial distribution change their direction outside and far from the dome

while gradients above uplifts without salt always point to the center of the uplift.

Figur 1. shows a gravity maximum above a known saltdome in *Texas* and Figur 2. the profiles of the same dome. The gravity effects of the profiles were calculated (the curves) and compared with the observed gravity anomalies (the dots). Altering the shape and masses of the dome until a saisfactory correspondence between the observed and calculated gravity values is obtained, it is possible from the *gravity results* to determine *the form* and *depth of the saltdome*. This is important also from a practical point of view, because the presence of a saltdome in *Texas and Louisiana* is always connected with occurance of *oil, gas* and perhaps of other valuable *minerals (sulphur)*. The accumulation of oil is mostly found in the sedimentary beds on the flank of the saltdomes, therefore it is of outmost impartance to determine as accurately as possible the exact position of the flank.

There is a *saltdome* in *Texas* the gravity effect of which in spite of a caprock shows a *gravity minimum* as given in Figur 3. In such cases the positiv gravity effect of the caprock cannot compensate the large negativ graviy effect of the saltmass.

In Figur 4. also a *gravity minimum* can be seen obtained above a saltdome with *thick caprock* but this caprock consists mostly of sulphur of small specific gravity and therefore the negativ gravity effect of the saltmass is predominant.

In *Texas* between 1923 and 1929 most of the saltdomes lying close to the surface were discovered by applying geophysical methods. Then the search was continued for the *deep lying saltmasses*. The *gravity effect* of such domes appears always as *a minimum* as shown in Figur 5. There is no exception from this experience, although these gravity minima are mostly of irregular shape. Furthermore the apex of such gravity minimum very seldom corresponds exactly to the actual axis of the dome partly on account of some regional effect, partly because of the assymetric form of the saltmass.

In case of such *deep lying* saltdomes the *oil* occurs mostly in the *uplifted sedimentary beds* just above the apex of the dome, the exact determination of which can be hardly done by the aid of the torsion balance. For this purpose the *reflexion seismic method* is generally applied.

The *seismic method* is based on the experience that the seismic waves *originated by explosions* have different *velocities* in the different formations. Spreading out from the shot point in all direction the seismic waves are *refracted* and, or *reflected* from a contact surface of two beds if they have *different velocities* for the seismic waves. In Figur 6. there are shown the seismic waves propagated in two beds with velocities V_1 and V_2 respectively.

In *salt* the velocity of seismic waves is considerably *higher* than in the overlying sediments, therefore there is a *distinct break* in the time-distance graph on places where the waves are *refracted* by the salt. Determining such points around the saltmass it is possible to contour on the surface a saltdome lying close to the surface. This is the *refraction seismic method* with the aid of which many saltdomes were discovered in Texas and Louisiana. Deep lying saltdomes can be detected by refraction shooting only if the *shot distance* is very *long* and a *great amount of explosives* are used which is — however — not *economical*.

The *reflection seismic method* uses the reflected seismic waves only (as shown in Fignr 7). From the time elapsed from the shot instant to the arrival of the reflected waves to the *pick ups (geophones)* the *depth* of the *reflecting horizon* can be calculated, provided that an average velocity for the seismic waves could be obtained. If more than on pick up is available then the *dip* of the *reflecting horizon* can also be determined from the small *time differences* found in the arrival of the seismic waves to the different pick ups. The reflexion seismic method is widely used to day and a great number of deep lying saltmasses were discovered with the aid of this method.

Magnetic surveys i. e. the determination of *magnetic anomalies* superposed on the normal magnetic field of the earth were also tried to find saltdomes because in some cases small magnetic anomalies were found above saltmasses. However the determination of these anomalies is uncertain and therefore the magnetic method is rarely used today for prospecting saltdomes.

There are various *electric methods* with the aid of wich the distribution of subsurface masses can be deliniated. These methods are based on that the *electric resistivity* of the different geological formaions *varies*, therefore if electric current is induced directly into the subsurface layers, from the alterations in the electromagnetic field caused by the induced current and measured on the surface conclusions can be drawn as to the *shape and location of the different formations*. Two different electric methods are mostly used today, those invented by Schlumberger and by Sundberg respectively. In the discoveries of saltdomes, however, the electric methods do not take such a prominant part as the torsion balance and the seismic methods.

The *newest geophysical istrument* used in the recent prospectings, especially in Germany, is the so called *gravimeter*. The determination of gravity with the aid of this instrument differs from the torsion balance survey, but the interpretation of the results is the very same in both methods.