layer of high conductivity at a depth of ~250 km, and also reveals further stratification overlying a uniform core of primaeval matter. The amplification of the lunar magnetic field produced by sudden increases in the planetary magnetic field is the key which has unlocked this secret. If the Moon were a homogeneous sphere of conducting material, electromagnetic induction could be expected to produce a current flowing so that its associated magnetic field would be dipolar, opposing the interplanetary field where this was incident normal to the Moon's surface and doubling the interplanetary field where it was tangential to the Moon's surface.

Surprisingly, however, the amplification of the increasing interplanetary field can be much greater than by a factor of two. The most plausible explanation of this phenomenon is that a dipole field induced in a conducting inner layer is compressed by the solar wind into the less conductive outer shell—although it should be borne in mind that the lunar geometry will not be quite as simple as a series of concentric spherical shells, this explanation is unlikely to be greatly affected by the known amount of anisotropy in the Moon. The conductivity required for the conducting mantle implies a temperature of between 450 and 950° C, depending on composition. So the thermal gradient from the surface to this mantle is about 3 K km^{-1}. Sonett *et al.* believe that the evidence for fractionation found in the available samples is equally well explained by the heating which would occur during the early life of the Moon as a result of the current generated in the conducting layer from a strong interplanetary electric field associated with the rapidly spinning pre-main sequence Sun; evidence for the sort of field required to fit the lunar observations is clearly apparent in the very young T Tauri stars.

There is therefore a very plausible history for the Moon, in which it had a "cold" origin—forming from the accretion of interplanetary dust—and was then subjected to heating of a non-nuclear origin during its life. Locally, there are regions of the mantle which have been heated enough to produce the observed lava flows, but the core itself has never been molten, and, although its temperature today is slowly rising, it is still composed of the original solid matter from which it formed.

EARTH'S CRUST

Hidden Transform Faults

from our Geomagnetism Correspondent

ICELAND is different things to different people, but to Earth scientists it is the only large land mass lying across the mid-Atlantic Ridge system. The Reykjanes Ridge enters Iceland from the south-west and the Jan Mayen Ridge leaves it towards the north-east; but it is what lies between that particularly interests geologists even though, by definition, it is hardly a typical spreading region. Is the ridge beneath Iceland a single continuous strip between the north end of the Reykjanes and the south end of the Jan Mayen? Or is it broken in some way, by transform faulting or otherwise? The Reykjanes volcanic zone in south-west and central Iceland is marked by en echelon faults which are probably the surface effect of deeper transform faulting. Indeed, Ward *et al.* (*J. Geophys. Res.*, **74**, 665; 1969) extended this faulting to the volcanic zone in eastern Iceland which they took as the present crest of the active ridge.

Within this system there are, however, two curious anomalies. For one thing, with both western-central and eastern volcanic areas there are suggestions of two active ridges, and for another there is Snaefellsnes—a volcanic zone, Pleistocene and Holocene, which forms a 120 km long east-west lenticular pile in the extreme west centre of Iceland. In other words, the Snaefellsnes zone runs perpendicular to the central ridge trend and, moreover, produces basalts which are chemically distinct from those produced in the eastern and central volcanic areas.

So why Snaefellsnes? It is hard to be certain, of course; but Sigurdsson (*Earth Planet. Sci. Lett.*, **10**, 129; 1971) has come up with a hypothesis which can explain the matter in general terms if not in detail. He supposes first that during the Pleistocene the eastern volcanic zone, which was the major north-south active zone and stretched the length of Iceland, was joined by a second active zone parallel at about 100 km to the west and again stretching the whole north-south length of Iceland. For a while, from about 1.5 to 0.5 million years ago, both zones lived happily together and spread merrily away. But during the late Pleistocene the northern half of the western-central zone ceased activity whereas the southern half remained active until at least the Holocene. At any rate there came a time when both zones were spreading below latitude 15° N but only the eastern zone was spreading north of this latitude. It is possible, of course, that the total spreading from the two southern zones was no greater than the spreading from the northern half of the eastern zone; but in so far as the eastern zone appears no wider in the north than in the south this is unlikely. Sigurdsson believes that there really was a differential spreading between north and south and that as a result something had to give.

What gave, of course, was the east-west boundary separating the regions of grossly differing spreading rates—and so Snaefellsnes was born. An east-west transform fault appeared between the two spreading zones and extended westwards through the Snaefellsnes region as a transcurrent fault. In other words, the Snaefellsnes volcanic zone is in theory of a different type from the central rift and transform zones; and this is supported in practice. The heat flow there, for example, is not anomalously high and the alkaline and transitional basalt volcanism produced there is in marked contrast to the tholeiitic volcanism in the other zones. Sigurdsson's hypothesis thus seems to fit the situation rather well; but at the same time there are a few not insignificant problems to overcome and which require more work in the field.

In the meantime, under vastly different circumstances and for rather different reasons, Bacon and Gray (*Earth Planet. Sci. Lett.*, **10**, 101; 1971) also think they have found a transform fault—albeit an old one—this time off Spain. What Bacon and Gray have done is to fill in another section of the almost complete gravity map of the Bay of Biscay. The free air anomalies in the Bay and especially in the newly mapped east are predominantly negative, indicating an area of subsidence and sediment accumulation. The large gravity low off northern Spain, in particular, Bacon and Gray interpret as an ancient fracture zone "along which a pre-Cretaceous west to east movement of Iberia of some hundreds of km occurred after the formation of the Bay".

The rationale behind this supposition is this. There is some evidence to suggest that the Bay of Biscay was formed by the rotation of Iberia about a pole at the western end of the Pyrenees, a phenomenon which is apparently contradicted by the fact that the Pyrenees show no increase in estimated crustal shortening from west to east. Bacon and Gray suggest that this problem may be overcome by assuming that after the rotation about the western Pyrenees pole the Iberian peninsula was left several hundred kilometres to the west of its present position relative to the rest of Europe. A subsequent easterly movement would then have been required.