amplify a biosynthetic energy difference; and factors other than biosynthetic energy that should also be considered costs of Trp synthesis (for example, the space that Trp synthesis preempts in the already crowded cytoplasm or membrane[3,10]). But all these considerations still predict incorrectly that the mutants should grow faster than the wild type when grown separately. Thus, the advantage of mutants must instead involve some interaction with the wild type when grown together, such as competition for glucose, the limiting substrate.

Similar doubts concerning the energy hypothesis emerge from experiments on *lac* operon proteins[3,11,12]. For example, Andrews and Hegeman[12] compared five strains of *E. coli* differing in production of *lac* operon proteins (from 0.6 to 3.6 per cent of total cellular protein) growing in media with a substrate other than lactose. The authors observed no significant correlation between selective advantage and percentage of wasted protein.

The traditional explanation in terms of saved biosynthetic energy appears to fail. The familiar observation that synthesis of specific proteins becomes phenotypically repressed in the absence of requirement for the protein is also usually attributed to saved energy. Experiments are needed in which the selective disadvantage of a mutant that cannot repress an enzyme in the absence of its substrate is measured and compared with the saved energy or other postulated costs. □

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Earth sciences

Magnetotelluric evidence for subduction of seafloor sediments

from D. Ian Gough

NEW results from magnetotelluric soundings across Vancouver Island reported by R.D. Kurtz, J.M. DeLaurier and J.C. Gupta elsewhere in this issue (*Nature* **321**, 596; 1986) provide the first correlation of high electrical conductivity with a seismic reflector at the top of a subducted plate. The good conductor, at depths of 20–50 km down the sloping plate, is best understood as composed of seafloor sediments and volcanic rocks that contain brine in their pore spaces, and carried on the Juan de Fuca plate as it subducted beneath Vancouver Island. If saline water is thus subducted at many convergent plate boundaries, the implications for the continental crust and the tectonic processes in it are important.

The magnetotelluric profile reported by Kurtz *et al.* forms part of the first of a series of transects across major structures in LITHOPROBE, the Canadian national programme of deep crustal studies. The central discipline of the programme is seismology, supported by other geophysical and geological techniques. In southern Vancouver Island three seismic reflection sections of outstanding clarity have been secured, showing both the subducting plate and much detail in the layered rocks above it (Green, A.G. *et al. Nature* **319**, 210; 1986). The magnetotelluric stations in the study of Kurtz *et al.* were sited along two of the three seismic profiles. At three stations, the top of the good conductor is correlated with a seismic reflector within 10 per cent of depths in the range 23–28 km. The results from all 18 stations in the study can be fitted to a two-dimensional model in which a sloping conductive layer correlates well with a seismic reflector interpreted as the top of the downgoing plate throughout the depth range 23–34 km. Such correlations facilitate recognition and interpretation of structures located in different physical parameters (such as elastic moduli and electrical conductivity). It is planned to obtain magnetotelluric profiles at high station density along future seismic reflection sections of LITHOPROBE on land.

Fluids in the crust are attracting increasing attention. Crustal water is of critical importance in the response of rocks to stress, in particular in the thrusting of rock sheets a few kilometres thick over areas of several thousands of square kilometres in continental collison zones such as the Himalayan, Alpine and Appalachian mountain systems. Crustal water has great economic importance in relation to metallic ore genesis and to maturation and migration of hydrocarbons. Such water is generally a brine (Fyfe, W.S. *et al. Fluids in the Earth's Crust* Elsevier, Amsterdam, 1978); the effects of the chemical reactions of this water with silicate minerals in the lower crust are being explored. A brine is a very good electrolytic conductor, and provided that it fills interconnected pore spaces or fractures it will give high bulk conductivity in the rock (Shankland, T.J. & Ander, M.E. *J. geophys. Res.* **88**, 9475; 1983). This is the interpretation of the conductive layer beneath Vancouver Island offered by Kurtz *et al.*

Saline water probably exists in crustal rocks of all ages. In tectonically active regions close to ocean ridges and subductions the silicate mineral of lowest melting point may provide another fluid that fills cavities between the other silicate crystals, both in the upper mantle and locally in the crust. Such partial melt is generally a good electrolytic conductor, and will produce high bulk conductivity if it is in interconnected spaces (Shankland, T.J. & Waff, H.S. *J. geophys. Res.* **82**, 5409; 1977).

In the interior of British Columbia, 200–600 km north-east of Vancouver Island, a large regional conductive layer is known to exist in the lower crust and uppermost mantle. I have suggested (*J. geophys. Res.* **91**, 1909; 1986) that this Canadian cordilleran regional conductor is caused by partial melt at upper mantle depths and saline water in the crust above. The evidence for subduction of seafloor rocks containing brine presented by Kurtz *et al.* gives one reasonable explanation of the accumulation of brine in the crust of the hinterland of the subduction. If similar evidence is found in other zones of subduction, the new result may lead to better understanding of the mechanisms responsible for the transfer of water into other regions of the continental crust.

It is to be hoped that magnetotelluric soundings will be added to the collection of seismic reflection profiles in other regions so that structures can be sensed in terms both of electrical conductivity and of seismic-wave parameters. Either saline water or partial melt produces contrasts of one to two orders of magnitude in electrical conductivity, whereas the corresponding effects on seismic-wave velocities and attenuations are of the order of 10 per cent. Magnetotelluric soundings should therefore detect fluids of both kinds with much greater sensitivity than can be achieved by seismology. On the other hand, seismology gives better location of velocity interfaces and faults. The two methods are complementary, and much more powerful together than either alone, as demonstrated in recent studies of the crust beneath the Rhenish Massif in Germany (Meissner, R. & Wever, T. *Am. Geophys. Union Geodynamics Ser.* **13**, 31; 1986, and Jödicke, H. *et al.* in *Plateau Uplift* ed. Fuchs, K. Springer, Berlin, 1983), as well as in the Vancouver Island studies of Kurtz *et al.* and of Green *et al.* □

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