PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Concluding Remarks

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Phil. Trans. R. Soc. Lond. A 1987 **321**, 275-276
doi: 10.1098/rsta.1987.0015

Phil. Trans. R. Soc. Lond. A **321**, 275–276 (1987) [275]
Printed in Great Britain

Concluding remarks

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The focus of this discussion meeting is strongly connected to that of the history of continental crust. I was reminded of G. K. Gilbert (1893), who said that 'the permanence of the continental plateau, though highly probable, is not yet fully established; and the doctrine of continental growth, though generally accepted, has not been placed beyond the field of profitable discussion'. Recently, Kerr (1985) remarked that we increasingly see continents as a 'collage of wandering fragments', and this present discussion has been most concerned with processes associated with this model. I think we are sometimes confused by what is formed, when we observe what is preserved.

Continental metamorphism presents us with a great puzzle. Given the present heat flow, stable continental regions have temperatures little above 400 °C at Moho depths; the continents should be dominated by facies of the lowest grades. Yet continental rocks show an amazing diversity of P–T régimes, far exceeding any normal range. Verhoogen (1980) wrote 'as deformation and orogeny are commonly associated with regional metamorphism, orogeny should perhaps be described as a thermal disturbance, rather than a mechanical one'. Modern metamorphic studies involve the central theme of tracking the convective style of the earth through time. We are now entering a new period of observation, where deep continental structure is being refined by seismic and electrical methods, while actual plate motions can be observed by satellites.

Many of the metamorphic terranes discussed at this meeting involve subduction and collision-related phenomena. Recent studies of the subduction process (Uyeda 1983; Yorath *et al.* 1985; Kaiko Staff 1985) are beginning to elucidate the critical problems of the mechanics of subduction and the materials involved (even serpentine and diamonds; see, for example, Schulz 1986; Ozima *et al.* 1985). Such studies feed back to the complex P–T paths now being revealed by the metamorphic record. Rocks show us the range of physical conditions, and place some constraints on time, while modern geophysics can show the mechanisms. We are reaching the point where petrology and geophysics are joining to produce sound models of dynamics and thermal history.

From the discussions at this meeting, it was clear that a great problem involves the uplift mechanisms of very deeply buried rocks (Fyfe 1986). There were hints that we may underestimate the influence of erosion in mountain belts, which may attain rates of 5 km in a million years (Press & Siever 1986). While the high-T–low-P paths associated with rifting processes were discussed, there was little mention of the potential influences of magma underplating of continental crust, a process which can double or triple the thermal gradient. We are all impressed by the recent studies (Chopin, this symposium), which show that light materials can be dragged to depths of 100 km or more (see Molnar & Gray 1979) and now it is being suggested that sinking lithosphere may even pass into the lower mantle (Kerr 1986). Perhaps the decades of description of metamorphic rocks and experimentation on their stability are beginning to pay off.

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