MID-OCEAN RIDGES

Ocean ridges spring surprises

Charles H. Langmuir

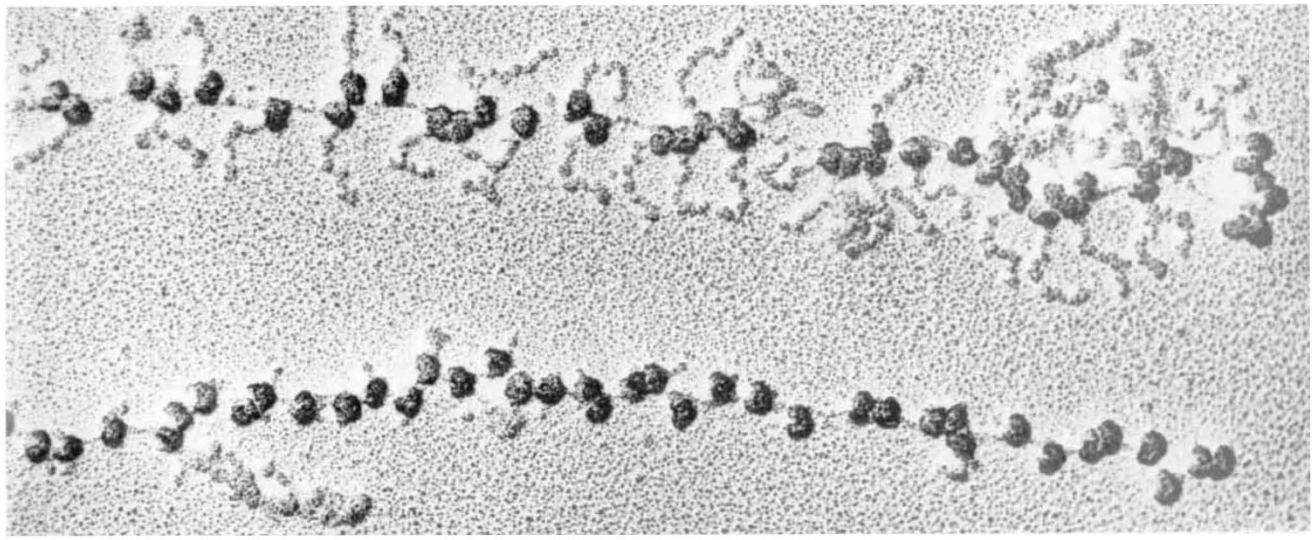
THE development of plate tectonics and early sparse observations of ocean ridges led to a simple and straightforward idea of how ridges worked. It was thought that ridges were linear spreading segments, periodically offset by transform faults. Slow-spreading ridges had small steady-state magma chambers and a central rift valley, whereas fast-spreading ridges had large, steady-state chambers and did not have a rift valley. A consequence of this simple view of ocean ridges is that a two-dimensional cross-section of a ridge was thought sufficient to describe its essential characteristics. New results from the slow-spreading Mid-Atlantic Ridge and the fast-spreading East Pacific Rise provide detailed observations that are inconsistent with aspects of these long-standing theoretical models of how slow- and fast-spreading ridges work. Kent and others, on page 650 of this issue[1], raise the possibility that the magma body beneath the East Pacific Rise is in fact quite small. And Lin and others[2] (page 627), show that the most common offsets of the Mid-Atlantic Ridge are not transform faults, and that slow-spreading crust formation is a fully three-dimensional process.

Estimates of the size of the East Pacific Rise magma chamber have decreased in recent years, based on results from studies of its bathymetry[3], petrology[4] and multichannel reflection seismology[5]. Kent and others constrain the size even further by a detailed analysis of multichannel seismic data from one of the currently most active portions of the East Pacific Rise near 9°30′ N. Their analysis suggests that the magma body may be only a kilometre wide and a hundred metres thick, a size so small that it merits the name 'melt lens' rather than magma chamber. Such a small body, supplied with magma from beneath the crust at multiple locations within a spreading cell[4], would help to reconcile geophysical and petrological data from the East Pacific Rise[4,5]. This melt lens is inconsistent with theoretical and ophiolite-based models of large, steady-state magma chambers at fast-spreading ridges. It calls for a new theoretical analysis of the heat budget at fast-spreading ridges. How can high-temperature magma be maintained in such a small magma body?

Lin *et al.*[2] and Sempere *et al.*[6] report equally remarkable results from a recent survey of the Mid-Atlantic Ridge. This survey, which included detailed observations of bathymetry, gravity and magnetic anomalies over a substantial section of the ridge, is one of the first of its kind for a slow-spreading ridge.

The bathymetric results from between 24° N and 30° N (ref. 6) reveal a length of 800 kilometres of ridge where there are no transform offsets at all. The ridge contains

Seeing the cellular translators at work



E. V. Kiseleva

IF there remain any doubters that the genetic message is translated by ribosomes moving in order along messenger RNA, gradually extending their individual protein chains and thereby producing a gradient of polypeptide chain lengths, they will surely be converted by the evidence of this micrograph (× 140,000), one of a number published by E.V. Kiseleva (*FEBS Letts* 257, 251–253; 1989). At bottom is the start of the polysome, at top the end, the rest of it looping out of shot.

This is not the first demonstration of its kind; similar pictures appeared in 1982 (Franke, C. *et al. EMBO J.* 1, 59–62; 1982). But the new pictures confirm that earlier work on the polysomes, and show our indebtedness to the lowly midge larva (*Chironomus*) for furnishing suitable material — salivary gland protein secreting cells — for such demonstrations. The genes that make these messages have provided our best views of transcribing genes *in situ*, and also of the transit of the resulting messenger RNP particles through the pore complexes of the nuclear envelope.

The polysomes in Kiseleva's preparations have the added interest of being attached by their 5′ ends to membraneous structures, presumably derived from the endoplasmic reticulum. This new information supports theories of the 'solid-state' transfer of RNA molecules throughout their cellular history (Agutter, P. *Prog. mol. Subcell. Biol.* 10, 15–96; 1988). In this instance the mRNA is attached to the membrane, though the possibility remains that there is also some involvement of the cytoskeleton, not preserved in the preparation.

The startling clarity of the pictures remains their greatest value. Ribosomes are frequently encountered in conventional transmission electron microscopy of thin sections, but that technique cannot reveal the detail of either the RNA itself, or the growing proteins attached to their ribosomes. The detail in Kiseleva's pictures enables us to see protein substructure; it is possible to count up to six beads towards the N-terminal end of the nascent polypeptides.

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