In this issue

Geodynamic energy and heat transport

Earth-energy has long been, to use Churchill's words, a riddle wrapped in a mystery inside an enigma. Currently popular models rely upon radiogenic heat for geodynamic processes, geomagnetic field generation, and for the Earth's heat loss. The problem is that radionuclides cannot even satisfy just the global heat loss requirements to say nothing of the great geodynamic energy requirements. Moreover, temperature increases with depth within the crust, but the three previously known heat transport processes within the Earth, conduction, convection, and radiation, appear unable to account for heat emplacement at the base of the crust. Herndon (**page 1605**), as a consequence of whole-Earth decompression dynamics (*Current Science*, 10 December 2005), adds a fourth heat transport process capable of emplacing sufficient heat at the base of the crust to drive crustal dynamics, volcanism and earthquake production and to account for global heat loss and the geothermal gradient.

Burden of haemoglobinopathies in Central East India

The hereditary disorders of haemoglobin may be grouped into two broad categories: haemoglobinopathies and thalassaemias. The haemoglobinopathies are characterized by the production of structurally defective haemoglobin due to abnormalities in the formation of the globin moiety of the molecule. The thalassaemias are characterized by a reduced rate of production of normal haemoglobin due to absent or decreased synthesis of one or more types of globin polypeptide chains. The thalassaemias are widespread, with maximum prevalence around the Mediterranean littoral and in southeast Asia. Sickle cell haemoglobin is prevalent in Africa and central-southern part of India, whereas, haemoglobin E in southeast Asia and north-eastern India, and haemoglobin D in Punjab and western India. Haemolytic anaemia results from an increase in the rate of red cell destruction.

Breathless on little exertion, excessive fatigue, tiredness or weakness, joint pains, pale nailbeds, eyelids, lips and tongue, and reduced activity in children are the symptoms of anaemia. Anaemia reduces capacity to work, increases the risk of maternal and foetal morbidity and mortality such as premature delivery, low birth weight, etc. and increases the susceptibility to infection.

Several rare types of thalassaemic disorders and haemoglobin variants have sporadically been reported from India. R. S. Balgir (**page 1651**) has reported the scenario of haemoglobinopathies in the Central Eastern part of India. He highlights a major public health and genetic problem of clinically significant haemoglobinopathies in the state of Orissa. The presence of thalassaemias and haemoglobin E in coastal part of Orissa and that of sickle cell in the central, western and southern Orissa has importance from historical perspective, migrations of people and genetic diversity of ethnic/predatory populations of India. This clearly shows that haemoglobinopathies are not confined only to tribal people but have penetrated the general and scheduled caste populations of the region unlike other parts of the country.

Wolbachia endosymbiont

The intracellular alpha-proteobacteria of the genus *Wolbachia* has been recently recognized to infect a wide range of arthropods. These were first reported in the reproductive tissues of the culicine mosquito, *Culex pipiens*, causing cytoplasmic incompatibility. Interests in this group increased when it was found that the infection and its effects were not limited to mosquitoes, but were also present in several other insect species. The bacteria manipulates the host biology in many ways, such as parthenogenesis, feminization, fecundity enhancement, male killing, etc. These bacteria are being identified using *Wolbachia*-specific PCR primers, such as 16S rDNA, ftsZ, WSP protein coding genes and are classified into eight super clades (A to H) based on nucleotide variability.

From the application point of view, *Wolbachia* is of interest as a tool to genetically transform insects for the modification of their disease-transmitting abilities and in controlling pests and predators by interfering with their *Wolbachia* symbionts. Keeping this in view, Prakash and Puttaraju (**page 1671**) have screened several insects and insect pests of sericulture importance for the presence of *Wolbachia* by using *wsp* primer in PCR technology. The information provided will lead to use of these bacteria as a tool to control insect pests of agriculture in general and sericulture in particular.

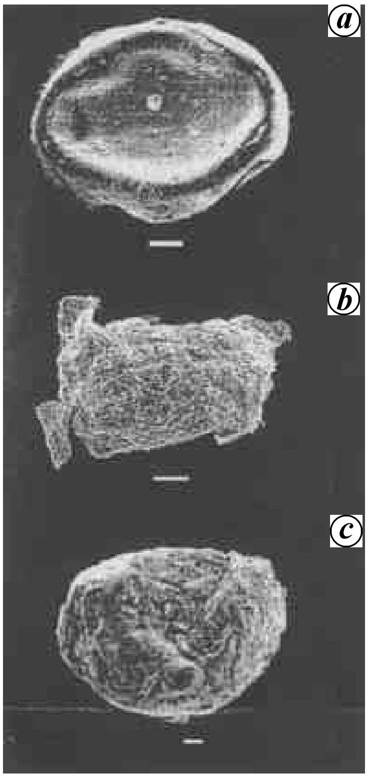

Figure 4. Samples containing thecamoebians.

Antarctica is described here as a subspecies, is known from bogs in Germany[14]. *Arcella vulgaris*, which is an important arcellacean, is known from the bogs in Arctic and further south in the Canadian region with pH[15] varying from 2.1 to 5.7. The *Difflugia* group apparently dominates in the water with higher pH of 6.7 or more[15]. Though the present assemblage is poor in content, the reflection of change in water pH is discernible from L-49/2 (with low pH and low dissolved solids, inhabited by *A. antarctica*) to L-49/3 (with higher pH inhabited by *Difflugia* sp.) in the Late Pleistocene–Holocene lake sediments.

1. Loeblich, A. R. and Tappan, H., *Treatise on Invertebrate Palaeontology, Part C (Protista)* (ed. Moore, R. C.), Geological Society of America and University of Kansas, 1964, pp. C16–C54.
2. McCarthy, F. M. G., Collins, E. S., McAndrew, J. H., Kerr, H. A., Scott, D. B. and Medioli, F. S., *J. Palaeontol*., 1995, **69**, 980–993.
3. Medioli, F. S. and Scott, D. B., *Palaeogeogr. Palaeoclimatol. Palaeoecol*., 1988, **62**, 361–386.
4. Mehra, S., Mathur, A. K. and Mehrotra, S. C., Proc. South Asia Geological Congress (GEOSAS-IV), New Delhi, Geological Survey of India, 2003, pp. 328–335.
5. Ravindra, R., Chaturvedi, A. and Beg, M. J., In *Advances in Marine and Antarctic Science* (eds Schoo, D. B. and Pandey, P. C.), New Delhi, 2002, pp. 301–313.
6. Ingole, B. and Dhargalkar, V., *Curr. Sci*., 1998, **74**, 529–534.
7. Sinha, R., Chatterjee, A., Panda, A. K. and Mitra, A., *Curr. Sci*., 1999, **76**, 680–683.
8. Sinha, R., Navada, S. V., Chatterjee, A., Sarvan Kumar, Mitra, A. and Nair, A. R., *Curr. Sci*., 2000, **78**, 992–995.
9. Sinha, R. and Chatterjee, A., *J. Geol. Soc. India*, 2000, **56**, 39–45.
10. Sinha, R., Sharma, C. and Chauhan, M. S., *Palaeobotanist*, 2000, **49**, 1–8.
11. Sinha, R., Sastry, V. N. and Rajagopalan, G., *J. Geol. Soc. India*, 2003, **61**, 717–723.
12. Kumar, P., Mohammed, R. S. and Mehrotra, Scientific Report. Dept of Ocean Dev., Tech. Publ., 2002, vol. 16, pp. 273–292.
13. Bera, S. K., *Curr. Sci*., 2004, **86**, 1485–1488.
14. Claparede and Lachmmann in Carter, H. J., *Ann. Mag. Nat. Hist. Ser. 3*, 1864, **xiii**, 18–39.
15. Patterson, R. T. and Arun Kumar, *J. Foram. Res*., 2000, **30**, 310–320.

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Energy for geodynamics: Mantle decompression thermal-tsunami

It is known through experience in deep mines and with bore-holes that temperature increases with depth in the crust. For more than half a century geophysicists have made measurements of near-surface continental and oceanic heat flow with the aim of determining the Earth's heat loss. Pollack *et al.*[1] estimate a global heat loss of 44.2 TW (1 TW = 10^{12} W) based upon 24,774 observations at 20,201 sites.

Numerous attempts have been made to reconcile measured global heat loss with radionuclide heat production from various geophysical models closely involved with plate tectonics. Usually, models are contrived to yield the very result they model, but in this case there is a problem. Currently popular models rely upon radiogenic heat for geodynamic processes, geomagnetic field generation, and for the Earth's heat loss. The problem is that radionuclides cannot even satisfy just the global heat loss requirements.

Previous estimates of global heat production invariably come from the more-or-less general assumption that the Earth's current heat loss consists of the steady-state heat production from long-lived radionuclides (^{235}U, ^{238}U, ^{232}Th, and ^{40}K). Estimates of present-day global radiogenic heat production, based upon chondritic abundances, typically range from 19 TW to 31 TW. These represent an upper limit through the tacit assumption of rapid heat transport irrespective of assumed radionuclide locations. The short-fall in heat production, relative to Earth's measured heat loss[1], has led to speculation that the difference might be accounted for by residual heat from Earth's formation 4.5×10^9 years ago, ancient radiogenic heat from a time of greater heat production, or, perhaps, from a yet unidentified heat source[2].

The purpose of this brief communication is to disclose a heretofore unanticipated heat transport mechanism and heat source capable of emplacing heat at the mantle–crust-interface at the base of the crust.

Since the first hypothesis about the origin of the sun and the planets was advanced in the latter half of the 18th century by Immanuel Kant and modified later by Pierre-Simon de Laplace, various ideas have been put forward. Generally, planetary formation ideas fall into two categories involving condensation at high-pressures, on the order of 10^2–10^3 bar, or condensation at very low-pressures. For the past several decades, the idea of Earth formation from matter that condensed at low-pressures of about 10^{-5} bar has dominated scientific discussion. Recently, I showed that such low-pressure condensation would lead to the contradiction of terrestrial planets having insufficiently massive cores, and showed instead the consistency of the idea of the proto-Earth raining out at high-pressures from a giant gaseous protoplanet[3].

The principal consequences of Earth's formation from within a giant gaseous protoplanet are profound and affect virtually all areas of geophysics in major, fundamental ways[3]. Principal implications result (i) from Earth having been compressed by about 300 Earth-masses of primordial gases which provides a major source of energy for geodynamic processes, and (ii) from the deep-interior having a highly-reduced state of oxidation which results in great quantities of uranium and thorium existing within the Earth's core, and leads to the feasibility of the georeactor, a hypothesized natural, nuclear fission reactor at the center of the Earth as the energy source for the geomagnetic field[4–7]. These consequences have led to a different way of envisioning geodynamics, recently published in *Current Science*[8], called *whole-Earth decompression dynamics*.

Formation of the Earth as the rock-plus-alloy kernel of a giant gaseous Jupiter-like planet, as I have shown[3,9,10], leads to the Earth as we know it being compressed to about 64% of its present diameter, and having a contiguous uniform shell of continental matter covering its rocky surface. After being stripped of its great, Jupiter-like overburden of volatile protoplanetary constituents, presumably by the high temperatures and/or by the violent activity, such as T Tauri-phase solar wind[11–13], associated with the thermonuclear ignition of the Sun, the Earth would inevitably begin to decompress, to rebound toward a new hydrostatic equilibrium. The initial whole-Earth decompression is expected to result in a global system of major *primary* cracks appearing in the rigid crust which persist and are identified as the global, mid-oceanic ridge system, just as explained by Earth expansion theory. But here the similarity with that theory ends. Whole-Earth decompression dynamics sets forth a different mechanism for whole-Earth dynamics which involves the formation of *secondary* decompression cracks and the in-filling of those cracks, a process which is not necessarily limited to the last 200 million years, the maximum age of the seafloor.

As the Earth subsequently decompresses and swells from within, the deep interior shells may be expected to adjust to changes in radius and curvature by plastic deformation. As the Earth decompresses, the area of the Earth's rigid surface increases by the formation of secondary decompression cracks often located near the continental margins and presently identified as submarine trenches. These secondary decompression cracks are subsequently in-filled with basalt, extruded from the mid-oceanic ridges, which traverses the ocean floor by gravitational creep, ultimately plunging into secondary decompression cracks, thus emulating subduction, but without necessitating mantle convection.

One of the consequences of Earth formation as a giant, gaseous, Jupiter-like planet[9], as described by whole-Earth decompression dynamics[8,10,14], is the existence of a vast reservoir of energy, the stored energy of protoplanetary compression, available for driving geodynamic processes related to whole-Earth decompression. Some of that energy, I submit, is emplaced as heat at the mantle–crust-interface at the base of the crust through the process of *mantle decompression thermal-tsunami*. Moreover, some radionuclide heat may not necessarily contribute directly to crustal heating, but rather to replacing the lost heat of protoplanetary compression, which helps to facilitate mantle decompression.

Previously in geophysics, only three heat transport processes have been considered: conduction, radiation, and convection or, more generally, buoyancy-driven mass transport. As a consequence of whole-Earth decompression dynamics, I add a fourth, called mantle decompression thermal-tsunami.

As the Earth decompresses, heat must be supplied to replace the lost heat of protoplanetary compression. Otherwise, decompression would lower the temperature, which would impede the decompression process.

Heat generated within the core from actinide decay and/or fission[15] or from radioactive decay within the mantle may enhance mantle decompression by replacing the lost heat of protoplanetary compression. The resulting decompression, beginning as low as at the bottom of the mantle, will tend to propagate throughout the mantle, like a tsunami, until it reaches the impediment posed by the base of the crust. There, crustal rigidity opposes continued decompression, pressure builds and compresses matter at the mantle–crust-interface, resulting in compression heating. Ultimately, pressure is released at the surface through volcanism and through secondary decompression crack formation and/or enlargement.

Mantle decompression thermal-tsunami, as outlined above, poses a new explanation for a portion of the internal heat being lost from the Earth. It may prove as well to be a significant energy source for earthquakes and volcanism, as these geodynamic processes appear concentrated along secondary decompression cracks.

1. Pollack, H. N., Hurter, S. J. and Johnson, J. R., *Rev. Geophys*., 1993, **31**, 267–280.
2. Kellogg, L. H., Hager, B. H. and van der Hilst, R. D., *Science*, 1999, **283**, 1881–1884.
3. Herndon, J. M., arXiv:astro-ph/0602232, 10 February 2006.
4. Herndon, J. M., *Proc. Natl. Acad. Sci. USA*, 2003, **100**, 3047–3050.
5. Herndon, J. M., *J. Geomag. Geoelectr*., 1993, **45,** 423–437.
6. Herndon, J. M., *Proc. Natl. Acad. Sci. USA*, 1996, **93**, 646–648.
7. Hollenbach, D. F. and Herndon, J. M., *Proc. Natl. Acad. Sci. USA*, 2001, **98**, 11085–11090.
8. Herndon, J. M., *Curr. Sci*., 2005, **89**, 1937–1941.
9. Herndon, J. M., arXiv:astro-ph/0408151, 9 August 2004.
10. Herndon, J. M., arXiv:astro-ph/0408539, 30 August 2004.
11. Joy, A. H., *Astrophys. J*., 1945, **102**, 168–195 (plus 4 unnumbered pages of plates).
12. Lada, C. T., *Annu. Rev. Astron. Astrophys*., 1985, **23**, 267–317.
13. Lehmann, T., Reipurth, B. and Brander, W., *Astron. Astrophys*., 1995, **300**, L9–L12.
14. Herndon, J. M., arXiv:physics/0510090, 30 September 2005.
15. Herndon, J. M. and Edgerley, D. A., arXiv:hep-ph/0501216, 24 January 2005.

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