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The contribution of CHAMP to global geology – answers and enigmas

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Potential field theory dictates that closely adjacent sources of magnetic anomalies can only be resolved when the field is measured at a distance from the sources no greater than their separation. From the point of view of resolving geological detail in the earth's crust, the CHAMP satellite is the best attempt yet, providing resolution on a scale of 300-400 km. Novel approaches to data processing and correction for temporal and other effects have provided sufficiently accurate determinations of the magnetic anomaly field attributable to the lithosphere globally to supply the long-wavelength variation pattern on which the first digital magnetic anomaly map of the world (WDMAM) has been constructed. For the first time, this brings together literally thousands of low-level aeromagnetic surveys and marine magnetic profiles to provide a map of magnetic anomalies worldwide of value to the improved understanding of global geology. Attempts at processing the CHAMP data to its highest resolution come close to revealing the patterns of magnetic anomalies in the world's oceans that arise from the repeated reversals of the geomagnetic field during ocean creation. These are incompletely sampled by the existing distribution of marine traverse data. Eruptions of large igneous provinces (LIPs) have left copious amounts of magma both on the continents and in the ocean basins where submarine plateaus like Kerguelen and subaerial ones like Iceland form major features of the world's geology. Some of their magnetic expressions are large enough to be recorded by CHAMP. Examples will be given from the Arctic Ocean and, in line with recent ideas on the initiation of Gondwana disruption, from the evolution of the southernmost Atlantic Ocean. An attempt at re-assembling the magnetic anomaly pattern over Gondwana by assembling the suitably processed WDMAM data for each of the constituent continents was partially successful but requires further work. Other pronounced lithospheric anomalies from CHAMP, such as that over Bangui in central Africa, remain enigmatic.