Mineral Sciences at the International Geological Congress

From August 20 to 28, 2004, 7493 registered participants from all over the world attended the 32nd International Geological Congress, Florence, Italy (http://www.32igc.org). The main subject of IGC had been proudly put forward by the organizers as “From the Mediterranean Area toward a Global Geological Renaissance: Geology, Natural Hazards and Cultural Heritage”. The IGC wanted to focus its attention on the applications of geological concepts to the understanding of a complex territory, the Mediterranean basin. Complex territory because it offers abundant artistic and historical records, as well as a wide range of geological problems (volcanoes, earthquakes, active tectonics, landslides, flooding, desertification, and so on).

Congress activities included plenary lectures, field trips, workshops, short courses and an amazing number of 336 different scientific sessions. Roughly, one third of the sessions at IGC were devoted to mineral sciences, covering almost the complete range of mineralogy, petrology, geochemistry, and allied disciplines. Topics as diverse as ophiolites, archaeometry, mineral engineering, biominerals, natural zeolites, gem materials, technical advances, mineral resources or arsenic contamination were covered.

Many of these sessions were sponsored by professional organizations such as the International Mineralogical Association (IMA), the European Mineralogical Union (EMU), the International Association of Geochemistry and Cosmochemistry (IAGC), the International Association on the Genesis of Ore Deposits (IAGOD), the International Association of Volcanology and Chemistry of the Earth’s Interior (IAVCEI), and so on. This wide participation demonstrated clearly the vital role of the mineral sciences in contemporary geology in providing quantitative tools to reconstruct the geological evolution from the local to the global scale.

Furthermore, mineral sciences were not limited to the sessions sponsored by the professional organizations or intentionally promoted by the Program Committee. In fact, mineral sciences were present throughout the IGC, including several sessions in which, at first glance, they did not appear to be involved.

As a mineralogist, every day I experienced the major problem of deciding which of the many sessions to attend. I imagine many of my colleagues from nearby disciplines faced the same dilemma.

In conclusion, as viewed from the 32nd IGC, mineral sciences appeared as a very active field, where many exciting discoveries are being made. New techniques (nanoscale probes, powerful spectrometers, widely available information, tremendous computing and modelling facilities), new specimens (from the HP environment of deep Earth, of cores from strategic boreholes, and of artistic and historical artifacts), new targets (the capability to cope with man-made geochemical contamination, the quantitative estimate of future scenarios, and the interaction between inorganic Earth and its biotic cover) are just appearing on the horizon. It is an exciting time to be here.

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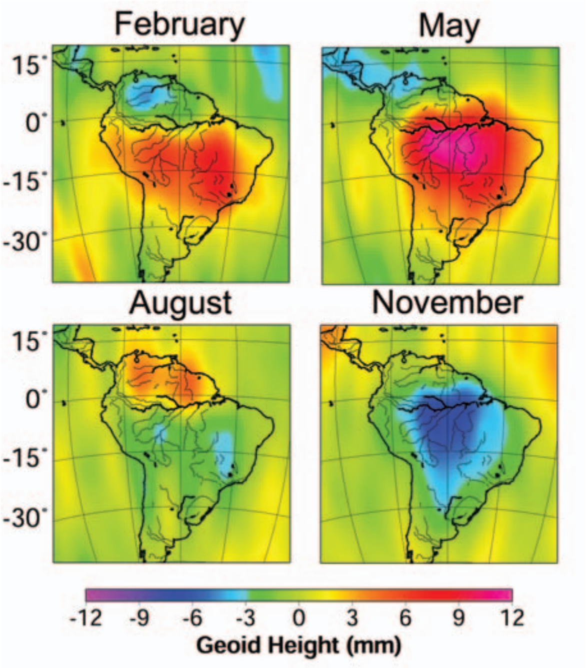
Read also reports on Goldschmidt 2004 (page 53) and CMS meeting (page 55).

Seasonal Changes Mapped by Geoid Height



Maps of the seasonal changes in the gravitational force in the Amazon basin when water accumulates as winter moves into summer, then becomes drier as summer moves into winter. The colors indicate very small changes in the height of the geoid, which is one representation of the level of gravity in an area. Reprinted with permission from Tapley BD, Bettadpur S, Ries JC, Thompson PF, Watkins MM (2004) GRACE Measurements of Mass Variability in the Earth System. Science 305: 503-505. Copyright 2004 AAAS.

The Earth’s water cycle involves the transport of water, in its various forms, between the atmosphere, land, and oceans. Measurements of the mass exchange between these systems is important for understanding and predicting climate change. Satellite based measurements, such as those from the joint NASA/DLR GRACE (Gravity Recovery and Climate Experiment) mission, are the only practical approach for obtaining global, synoptic and accurate measurements of this mass exchange. The GRACE geoid estimates afford the means to track the total change in water mass on a regional basis. Recent monthly gravity field estimates from GRACE have a geoid height accuracy of 2 to 3 mm at a spatial resolution as small as ~400–600 km. The annual geoid variation observed by GRACE is dominated by the spring-fall component, with peak magnitudes ranging from -7.2 mm to 8.9 mm. Previous space-based methods determined annual variations in the gravity field only at a scale of 5000 kilometers or longer, which was too large for most regional applications. The monthly geoid variations observed by GRACE over South America for 2003, which can be largely attributed to surface water and groundwater changes, show a clear separation between the large Amazon watershed and the smaller watersheds to the north.

Comparisons of GRACE observations with a terrestrial water storage model for the same time span show disagreement in areas where most models are known to be in error. It is known that contemporary, global continental hydrology models leave out important components of the water cycle that have been difficult or impossible to measure through direct observation (e.g., deep aquifers and polar ice cover). Such intercomparisons with GRACE results are expected to be useful in constraining the model output, bringing the two into better agreement.

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