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Geoinformatics in sedimentary geology and paleontology at the US National Science Foundation

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Sedimentary and paleontological sciences were among the earliest fields of geology. They continue to be of immense societal relevance to such diverse problems as global change, developing world economies, natural resources, especially water, our ever-growing concern for environmental and biological systems, and mitigating the impacts of natural hazards and catastrophes, especially as our burgeoning population moves into more hazardous areas.

Historically, sedimentary geologists and paleontologists explored their science as individuals. The data generated has been only partly presented in publications, with most stored in scientist's minds and personal data records. Collecting these data is both complex and labor intensive because they must be assembled from single points in space and time across a spectrum of scientific specialties. Just a fraction of the information lost over the last 150 years would make major contributions to key questions, such as: 1) the nature of biologic extinction, origination, and radiation, where understanding requires careful linking of deep-time and modern records; 2) the Earth's deep-time record of extreme climatic events, especially the transitory and rapid changes that are not observed in the Quaternary and younger record; and 3) improving the resolution of the geologic time scale, which requires the correlation of a broad array of data and offers answers to a variety of geologic questions.

Unfortunately, existing IT systems are still inadequate at handling these data types. While seismological data lends itself to a single distribution system, sedimentological and paleontological data is complex and sometimes qualitative in nature. A similar

problem is posed to medicine, where complex pattern recognition drawing on a variety of data types is required to make simple diagnoses. Recent advances in IT offer the possibility, however, of solving these problems.

The database architecture for a sedimentary geology and paleontology IT system should provide for real (quantitative) data down to the lowest biological, mineral, and chemical taxonomic levels and precisely located within the Earth's sedimentary crust. Interpretive research results (qualitative data generation) should be left to those who are accessing and utilizing the quantitative data and the toolboxes provided. Finally, the system must reduce the barrier to entry by making the results of this work more accessible to policy makers, the general public, and scientists from other disciplines.

But how do we develop this system and capture the latent knowledge? The international sedimentary geology and paleontology community must develop a publicly-owned, publicly- accessible, and publicly- maintained geoinformatics system that serves an international community and crosses traditional science and administrative boundaries. Large volumes of data must be captured, archived, analyzed, integrated, visualized, numerically modeled, and interpreted. Decision-makers must be persuaded that investment of resources toward developing this system will significantly advance the science, produce new insights with societal impacts, and demonstrate its importance through provocative outreach. Through an international and coordinated process, such a system could define the future of sedimentary geology and paleontology. The US National Science Foundation recognizes the need for developing and maintaining this geoinformatics system. We are funding and coordinating efforts across the traditional boundaries of our agency (terrestrial, marine and polar) and scientific disciplines (sedimentologic, stratigraphic, paleontologic, geochemical, paleomagnetic, radiogenic, etc.). Examples are the data associated with the Antarctic sediment cores where a new program that targets glaciation and global climate change (ANDRILL) is being started. We also will be documenting the fingerprints of ocean chemical processes locked up in oceanic sediments through a new funded effort called SedDB - so we can more fully understand the role of the world's oceans in both climate change and environmental geochemistry. And finally, through two new initiatives named the CHRONOS-Paleostrat System and Geosystems, we are assembling the data to unravel extreme climatic events in deep time to maximize prediction of future climate change. We are also emphasizing education and outreach projects such as PaleoPortal. One of the major hurdles, however, is overcoming community inertia in recognizing that these worthwhile endeavors require a coordinated effort and that individuals should, whenever possible, submit their data to appropriate databases. It is critical that the sedimentary geologic and paleontologic community work together across traditional boundaries to assure the usefulness of such an international, interoperable system.