WOLLASTON MEDAL

Richard H Sibson
Professor Emeritus, Department of Geology, University of Otago, New Zealand

Coupled Fluid and Fault Activity Near the Base of the Seismogenic Zone (How Faults Get Loded)

Geophysical observations in areas of actively deforming crust (e.g. NE Honshu) are combined with studies of exhumed fault-rock assemblages to provide insights into the the physical conditions of seismogenesis and the critical transition in fault zone rheology defining the base of the continental seismogenic zone at 15±5 km. A mixture of continuous and discontinuous shearing at varying strain-rates occurs within this transition region in response to the cycling of shear stress and pore-fluid pressure, recorded in associated hydrothermal vein systems. Especially in compressional setttings, intermittent large-volume discharge of hydrothermal fluids through extreme 'fault-valve' action at this structural level may lead to the formation of significant fault-hosted Au-quartz lodes. There is the tantalizing possibility that the lodes represent ancient rupture nucleation sites. One important consequence is that fault failure under such circumstances may be driven predominantly by the accumulation of fluid overpressure rather than tectonic stress. Another, on a broader scale, is that the dramatic lowering of strength below the upper crustal seismogenic layer, locally enhanced by trapped overpressures in the mid-crust, may generate decoupling horizons and the detachment of upper crust 'flakes' in collisional settings.

LYELL MEDAL

William F Ruddiman
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New Support for the Early Anthropogenic Hypothesis

The scientific community has for years debated the cause of the gradual CO_2 and CH_4 increases during the last several thousand years. Accumulating evidence now suggests that the natural explanations for these greenhouse gas increases can be rejected. Because CO_2 and CH_4 concentrations during the early parts of 7 previous interglaciations overwhelmingly trended lower, they falsify natural explanations for the upward trends during the late Holocene. Natural explanations for the methane increase during the last 5000 years are further rejected by the fact that emissions from the two largest natural CH_4 sources --- boreal and north-tropical wetlands --- were decreasing. The anthropogenic explanation for the rising CO_2 trend since 7000 years ago finds new support from a land-use modeling simulation that allows for the large per-capita clearance by early farmers practicing shifting cultivation. This simulation shows pervasive clearance of forests in Europe, China, and India by 2000 years ago, in agreement with studies by land-use archeologists. CO_2 feedback from a Holocene ocean kept anomalously warm by agricultural releases of CO_2 and CH_4 further enhanced the anthropogenic contribution.

MURCHISON MEDAL

Randall Parrish
Head of NERC's Isotope Geosciences Laboratory

Exploring the earth system, grain by grain, with a map, hand lens and mass spectrometer

My research involves considerable, perhaps eclectic, diversity and crosses boundaries between earth science, environmental science, mass spectrometry and environmental health. It has constantly involved working with colleagues, resulting in a very rewarding career. Tectonics: In the Himalaya, I regard the apparent thinning of the Tethyan Sedimentary Series and its underlying Greater Himalayan Series towards the east as it approaches the Eastern Syntaxis as one of the least understood tectonic topics of the Himalaya – why and how does this come about? Equally perplexing in the eastern Himalaya of Bhutan and Aranachal Pradesh are the preserved klippen of Tethyan rocks above the Greater Himalaya Series near the Himalayan front. How and why has the eastern Himalaya diverged in tectonic and erosion history from the central and western Himalaya? Isotope geochronology and field studies are a key to working out this puzzle. In rocks of the Himalaya (and elsewhere) that have come from UHP depths, we need know more of the rates of exhumation and the structures that have carried them at plate velocities to near the surface. Mass spectrometry and environmental science: Striving to improve the resolving power of thermo- and geochronological methods in its widest sense has been one of my constant research companions for the past 25 years; it is currently focussed on using improved LA-ICP-MS methods to do better Pleistocene carbonate dating, improve spatially-resolved dating of minerals in metamorphism, better reconstruct the tectonic and erosional history of orogens from their detritus, and to work with colleagues in the EARTH-TIME project to improve the accuracy and precision of U-Pb dating methods worldwide. Environmental Health: to continue specific environmental health research on the effects, if any, of inhaled depleted uranium oxide and help develop for the medical sciences better Pb biomarkers for use in epidemiology. It gives me great satisfaction to apply field and laboratory methods to such a wide set of problems, and to have this recognised by the Geological Society.

WILLIAM SMITH MEDAL

Henry W Posamentier
Senior Consultant Geologist, Chevron Energy Technology Company, Houston, Texas

Exploring the subsurface – applications of integrated seismic stratigraphic and geomorphologic analyses from the deep abyss to the alluvial plain

Analyses of three-dimensional seismic data have revolutionized the study of stratigraphy and sedimentology. Such seismic data can afford continuous imaging of the subsurface both in cross-section as well as plan view. This integration of seismic stratigraphy and seismic geomorphology has lead to significant advancements in understanding in fields ranging from process sedimentology to stratigraphy and depositional systems analysis. In the petroleum industry, integrated seismic stratigraphic and seismic geomorphologic analyses are used to effectively

predict lithology ahead of the drill bit, recognize and anticipate stratigraphic architecture, and identify stratigraphic compartments that influence how hydrocarbons are trapped. This approach is applied in two ways; firstly at exploration depths this integrated approach focuses on the direct search for and development of hydrocarbon accumulations. Secondly, this approach is applied to near-surface sections, where data quality is commonly significantly higher than at exploration depths, to identify analogs for similar depositional features encountered at depths where hydrocarbons are trapped. In particular, plan view images, which in some instances can yield exquisitely detailed views of ancient landscapes and seascapes, can provide unsurpassed windows to the ancient world, providing geologists with unparalleled tools for unraveling the mysteries of how sedimentary basins fill. By comprehensively integrating seismic stratigraphy and seismic geomorphology, we can anticipate that further significant advances will be made in the science of sedimentary geology and stratigraphy.