

Through examples it has been argued that the participation of local communities in water management is better organized and more effective than the governmental agencies. Cooperative management by user groups to facilitate water use in an equitable manner seems inescapable since such cooperation is critical for sustainable use of water.

Two new issues of water would increasingly emerge in the region in the coming years. First, water will be seen as a basic human right<sup>6</sup>. Secondly, the satisfaction of water needs for maintaining the ecosystem services has also started to emerge as an important item for allocation. The current water resource management policies and practices in South Asia have offered little to nations as well as to the communities on these issues. The policy statements are neither supported by institutional infrastructure and mechanisms, nor by enabling legislation nor by supporting economic incentives structures. For nations it is important to listen to the views of 'non-state actors' that may not follow mainstream policy wisdom. Accepting the challenge would involve recognition of the multifaceted nature of water as a resource, accepting that the local communities have the rights over its use and control, and that water cannot be reduced, categorized and classified, and manipulated and treated like other objects. It is now a challenge to evolve strategies towards an equitable and sustainable water future both at the national and regional levels by creating a radically transformed institutional framework for quick policy changes<sup>7</sup>. The positions between the civil society and the state agencies have now become polarized around water resources, and it is necessary to create a space for interaction.

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**Annual Review of Earth and Planetary Sciences, 2008.** R. Jeanloz *et al.* (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA94303-0139, USA. Vol. 36. 669 pp. Price not mentioned.

The *Annual Review of Earth and Planetary Sciences* is completing 35 years with the publication of the present volume (2008, vol. 36). The present volume contains wide-ranging topics. The preface highlights some of the important updates with the announcement of a new series, the *Annual Review of Marine Sciences* – a small dispersion to the existing forum. The basic thrust of the current issue is on following five broad areas: (1) Tectonics and earth internal processes; (2) Terrestrial climate, surface and subsurface processes; (3) Biological evolution through time; (4) Planetary evolution and atmosphere, and (5) Physics of the earth's processes and application.

The major emphasis of this volume is on tectonics and the earth's internal processes – with the majority of the articles covering topics on the evolution of continental crust, slab melting, mantle and core–mantle evolution.

The dynamics of the accretion process along the Pacific that led to the growth and evolution of the Andes is discussed in the chapter on 'The basement of the Central Andes: The Arequipa and related terranes' by V. A. Ramos. The chapter is probably an augmentation to the earlier series of papers published in the GSA special paper 407. Here the discussion consists of analyses on the evolution of the basement of the central Andes during the Mesoproterozoic and early Paleozoic time-period, with repeated events of extensional and contraction of tectonic regimes, accompanied by modification in absolute motion of the Gondwana super-

continent. The following chapter on 'Modeling the dynamics of subducting slab' by M. I. Billen discusses the laboratory experiment and field validation. The author presents geophysical, petrological and geochemical signatures of the subducting lithosphere plate to constrain slab geometry. The discussion deals with the application of recent computational techniques and advancement in laboratory tools to demonstrate the balance between two forces; driving and resisting forces influenced by factors like slab depth, rate of movement, evolution along with slab geometry, water content, grain size and chemical composition. While 2D simulation on time-bound evolution of slab characteristics is a feasible option, 3D modelling requires further understanding of balancing forces. There are only a few available active transform faults which can serve as a natural laboratory for understanding the fault mechanism, seismic activity, plate motions and internal structure. The Dead Sea active fault system is unique in this respect, displaying an active tectonics since the last 18 Ma. The chapter describing the 'Geology and evolution of the southern Dead Sea fault with emphasis on subsurface structure' provides enough reason to rethink about the relationship between rate of plate motion and deep seismic events commonly observed in the region.

Mantle is one of key internal structures of the earth, widely understood for its participation in the tectonic activities observed today. The mineralogical composition, petrography and geochemical character of the mantle minerals are distinct and indicative of oxidation states of different elements. The upper mantle is the differentiated component of the entire mantle with the presence of high abundances of minerals signifying regions of oxygen enrichment. As a consequence of high level of oxygen in the fluid speciation of C–O–H-bearing fluid, melt occurs influencing the mantle solidus and properties of the resulting liquid. The deep mantle is chemically reduced and compositionally depleted in large-ion lithophile elements, reflected with enhanced content of methane and metallic Fe. The review provides important information regarding geophysical and geochemical evolution of the mantle during geological timescales.

The second major thrust of the volume is on the earth's climate, surface and subsurface processes. The present under-

standing of impact of global warming on global circulation, more particularly thermohaline flow, is discussed in a chapter by Barreiro *et al.* The effect of collapse of circulation as a result of reduction in thermal gradient is a matter of societal concern – as discussed in the chapter both based on numerical simulation studies and an ensemble of observation revealed impact of collapse of thermohaline on climate phenomena like temperature and rainfall over equatorial region. The issue of sea-level rise due to global warming is dealt in the chapter titled ‘Coastal impact due to sea level rise’. The effect is visible in the region lying in proximity to the land–sea boundary; especially populations exposed along coastal townships are vulnerable to flooding, storm surges, tsunamis and extreme astronomical tides. The consequences of these forcings discussed in this paper include landward migration of barrier islands and beaches in response to enhanced sea levels. Impact of climate change is also noticeable in the arid regions of the world. A chapter on the history and nature of wind erosion in arid and semiarid regions by A. S. Goudie provides a comprehensive account of the application of remote sensing towards possible reconstruction of the power of wind erosion. The author discusses the relationship of wind power with formation of geomorphologic features like depressions, inverted relief, stone pavements, yardangs and dust storms.

Another prominent feature of this volume is the discussion on topics related to biological, biogeochemical evolution with special reference to early life and evolution. Many of the primordial ocean basins where life began have experienced conditions like oxygen depletion, critical for the origin and evolution of life. Major episodes of anoxia are documented in the geological record and the chapter on ‘Oceanic Euxinia in earth history: causes and consequences’ inscribes some of the observations from modern and geological past. Here the authors discuss the inventory of nutrient phosphate, critical for enhancing the productivity of surface ocean and consequent decrease in oxygen supply to the deep ocean – a scenario observed in the past (Late Devonian, Late Ordovician and Late Permian) and expected to happen during extreme greenhouse climate intervals. A secular reconstruction of Mo isotopic ( $^{97}\text{Mo}/^{95}\text{Mo}$ ) anomaly in sea water to identify

deep oceanic anoxia through time will allow an understanding of the impact of anoxia on geological extinction events. The past decade has seen a resurgence of interest in the evolution of species. The chapter titled ‘Crinoid ecological morphology’ describes the rich morphological record of Crinoid fossils and provides a connection with extant echinoderms. The paper deals with recent advancement in the understanding of evolution of crinoids with findings about crawling and arm-shedding behaviour observed on echinoderms from deep-ocean submersible studies. The author emphasizes the properties of connective tissues and motility, and discusses their significance in the Phanerozoic time-period. Biogeochemical behaviour of Fe in aqueous environment is driven by pH and Eh conditions. Microbial process involving  $\text{Fe}^{3+}$  reduction produces the largest isotopic fractionation of Fe isotopes ( $^{56}\text{Fe}/^{54}\text{Fe}$ ) in the natural system and records are well documented from the study on Archean samples. The chapter on ‘The iron isotope fingerprints of redox and biogeochemical cycling in modern and ancient earth’, describes the sedimentary records preserving the signature of increased bacterial sulphate reduction and temporal C, S, and Fe isotope variability from geological timescales.

Finally, it is important to mention two chapters on topics related with planetary science and space exploration. The chapter titled ‘The rest of the solar system’ elucidates outstanding contribution towards understanding space plasma, planetary magnetosphere and discovery of unexpected characteristics of Galilean moons of Jupiter. It seems particularly fitting that the volume begins with an article by M. G. Kivelson whose *Europa’s Ocean* (published in 2000) has been a standard work of enormous importance. After Mars, it remains the most attractive extraterrestrial environment within our solar system, to seek evidence of past or present life. The second chapter provides glimpses about the spatial content of Martian atmosphere from various spacecraft missions. M. D. Smith provides a compilation of data from all the NASA missions, which displayed a year-to-year variation in Martian atmospheric temperature and circulation patterns.

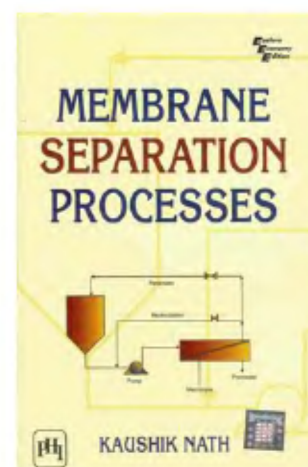
The review will be incomplete without mention of the chapter on ‘Diffusion in solid silicates: A tool to track timescale of processes comes of ages’ by S. Chak-

rabarty. Here the author uses diffusion as a clock to monitor the earth processes in a timescale ranging from a few days to millions of years. The potential application of Arrhenius equation relating diffusion coefficient as a function of time and temperature is demonstrated in this paper.

In conclusion, the present volume provides insightful updates on increased applications of physics, chemistry, biology and computational science in solving the conceptual issues of earth system sciences.

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**Membrane Separation Processes.** Kaushik Nath. Prentice Hall of India Private Limited, M-97, Connaught Circus, New Delhi 110 001. 2008. 322 pp. Price: Rs 295.

This book has 14 chapters and covers most of the aspects of membranes. Chapters 1 and 2 provide the various technical processes involving membranes. Chapter 3 is about reverse osmosis and chapter 4 about nanofiltration. In these chapters the approach taken is to describe simple mathematical models and rearrange the matter and the style of unit operations. Similarly, the author goes on to present important subject matters such as ultrafiltration, microfiltration, dialysis in various chapters and without exception his presentation has been excellent. There are several numerical examples