Editorial

Sedimentology: Science and Society

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The current world human population is about 7.834 billion as of 25 December 2020 according to the most recent United Nations estimates elaborated by Worldometer. The sustenance and development of civilizations is primarily based on water, mineral and soil resources, and oil and gas hosted in the sediment profile of Earth's crust. The study of natural sediments and sedimentary rocks, and the processes involved in their formation are embedded in the domain of sedimentology. The science of sedimentology is as old as very beginning of the study of geology itself. The term *sedimentology* was first used by A.C. Trowbridge in 1925 (Waddell, 1933), but it was not in common use until the 1950s. The progress of sedimentological studies has passed through various phases during the last about two centuries: 1) development of sedimentary petrology initiated by the Western European School (1849-1950s); 2) granulometry and sedimentation by American School (1920s-1960s); 3) lithology and facies analysis by the Russian School (1870s-1970s).

In the course of development of stratigraphy, sedimentological concepts got new impetus on 1) establishment of the concept of unconformity, 2) geometry of strata based on the geologic maps and stratigraphy, 3) establishment of uniformitarianism and actualism, 4) founding of the facies concept, 5) sedimentary processes and palaeoenvironments, 6) basin analysis, 7) seismic stratigraphy, 8) sequence stratigraphy and 9) chemostratigraphy. With the advancement of modern concepts in sedimentology, the International Association of Sedimentologists (IAS) was founded at the International Geological Congress in Algiers on 11 September 1952, to promote the study of Sedimentology and start of the International Sedimentological Congress (ISC). It was in early 1960s with generous research funding by the industry particularly oil and gas industry sedimentology has come into the new era as an established discipline of earth sciences. This led to organization of educational and research institutes, trinity approach of sedimentary petrology, sedimentation and facies analysis in sedimentology; internationalizing and extension of sedimentology, and planetary sedimentology. It was in 1975 during a symposium at Delhi University the Indian Association of Sedimentologists was established and the first convention was held at Delhi University in 1976.

The contributions of Sedimentologists in the development of the society are of vital importance. May it be the contributions in technical knowhow about discovery and exploitation of earth resources, environment, climate record, atmospheric sciences, natural and anthropogenic hazards, earth surface processes, etc. The present day challenges in earth resources exploration is increasing gap in energy production and demand. The future sustainable 35% energy demand is expected to be met from tight gas and tight oil in shale resources. The longstanding understanding that mudstones form in standing or slow-moving waters has been facing challenge by the concept that "muds accumulate even when currents move swiftly. The research shows that some mudstones may have formed in fast-moving waters: "Mudstones can be deposited under more energetic conditions than widely assumed, requiring a reappraisal of many geologic records (e. g., Schieber et al., 2007). These results call for critical reappraisal of all mudstones previously interpreted as having been continuously deposited under still waters. Such rocks are widely used to infer past climates, ocean conditions, and orbital variations (Macquaker and Kevin, 2007). Considerable recent research into mudstones has been driven by the recent effort to commercially produce hydrocarbons from them, in both the shale gas and tight oil plays (Loucks, et al., 2009).

Human activities on the earth surface including changing land-use pattern and release of pollutants into the natural environment result in adverse impact on society. We need to raise social awareness of these environmental changes and their future consequences, and predict implications and formulate mitigation strategies. Sedimentologists have critical role to play in characterizing and quantifying the response of nature to the impact of human activities on natural environment vis-à-vis society. There are many opportunities for sedimentologists to contribute in understanding of the human-nature relationship and help to achieve the UN sustainability goals (United Nations Sustainable Development Goals, 2015). Natural hazards like earthquakes, volcanoes, tropical cyclones, dam bursts, landslides, river floods, glof, soil erosion, etc. which directly or indirectly impact human communities are the areas where sedimentology can play/plays a key role in improving our understanding of sediment mobilization, deposition and processes involved in interplaying with nature and natural resources. For example, how seasonal land-use can dramatically disrupt sediment transport, and alter the potential for erosion. On an average out of 500,000 earthquakes, about 100 great earthquakes occur every year in the world. The instrumental records of these earthquakes are available only for the last c.100 years. We don't know details on location, magnitude and mechanics of the historical records. Subaqueous fossil landslides potentially preserve a valuable record of the historical great earthquakes which provide clues to understand their frequency of occurrence and the pattern. Climatic and land-use changes (natural or man-made) play important role in triggering natural hazards. Climatic changes in combination with tectonic and volcanic activity also impact small islands (viz., small island nations in the Indian Ocean) and coastal regions around the world. The impact of human activity on natural systems involves complexities in sedimentary routing systems from source to sink. For example, how pollutants and particulates are formed from natural and artificial sources, transported and deposited within the deep seas. Fine-grained sediments impact aquatic ecosystems, water quality, and increase flood risk in large river systems. The implications of future climate change may also affect the rate and nature of such transport. Climate change is the main driving force that shall affect global distribution of water on earth surface in future. It has already effected water variation in some regions in the world including the Himalayan countries which face rapid decline in water reserves. This climate change-driven water variation is likely to affect transboundary water sharing treaties and agreements, and may force the water sharing nations either to conflict or less likely cooperation policies. Great river systems emanating from huge glaciers in the Himalaya; the Brahmaputra, the Indus, the Sutlej, the Salween and the Mekong pass through 11 countries and nourish about 2 billion people in South Asia. Alone, the Indus River system feeds about half a billion people in North India and Pakistan. In the absence of surface water sources, we will have to depend on ground water resources for drinking, agriculture, industry, and other purposes. But we are also polluting the ground water resources by injecting sewerage water into the ground through soakage pits particularly in urban areas. We don't know much about the complex routing system of percolation of particulate and dissolved toxic elements through sediment cover into the water table. The effect of plastic pollution in the natural environment and water bodies is another grave concern. Deep sea is thought to be the ultimate sink for plastics particularly microplastics (Woodall et al., 2014). Less than 1% of the plastic in the oceans floats on the surface (Jambeck et al., 2015; Van Sebille et al., 2015), where does the remaining plastic accumulates or settles down? The research on deep-sea processes involved in transportation of plastic particles in deep seas shall fill the knowledge gaps in this field.

To arrest the atmospheric CO_2 and store it in the earth's sedimentary cover is critical to reduce and mitigate the release of natural carbon. We don't know how subsurface sedimentological variations within the potential CO_2 storage in sandstone reservoirs will impact the subsurface environments. Carbon sequestration is still poorly understood which limits our understanding of the carbon cycle as a whole. Future research should be focused on characterisation of spatio-temporal heterogeneity of the sedimentary deposits which apparently have dominant control on organic carbon hotspots within the earth system (to better constrain the spatial and depth-related variability in natural organic carbon sequestration). Carbon capture and storage can offer a promising anthropogenic solution in mitigation against the release of CO_2, perhaps utilizing the existing petroleum fields for the purpose.

Coastlines and ocean Islands are often densely populated areas which are vulnerable to sea level rise. Understanding how ecosystems of coastlines and Islands change in response to climate change is the key for sustainable development of these regions. For example about 60% of coastline population of India is affected by the coastal pollution and climate changes. Coastal and shallow marine environments are also potential areas for the growth in renewable wind energy. Understanding of the subsurface geology in the coastal areas particularly in deeper settings is important for foundation of infrastructure development of wind turbines to maximize the wind energy resource. Research on present day coastal sedimentation processes and ancient analogues is critical for providing insights into how systems react to external forcing (processes) and subsurface sedimentary stratal architecture.

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