Editorial

Tectonics & Sedimentation

Deformation, on a range of scales, is an important control on the sedimentary architecture within a basin. The extent of structural deformation within a region commences at the plate-tectonic scale (e.g. rift initiation to oceanic ridge formation) affecting both the size and locations of oceans and continents as well as the size and nature of large source areas, sediment transport pathways and the locations of depocentres, and extends down to the basin scale, where tectonics control the overall structural framework (e.g. compressional, extensional), as well as basin size and the degree of basin compartmentalisation (e.g. synthetic/antithetic faults, variable uplift/subsidence). Many depositional processes are gravity controlled, and thus any changes in slope engineered by tectonic activity can lead to significant changes in both the amount and distribution of sediment within the basin.

The relationship between tectonic activity and sedimentation within a basin, however, is a complex one given the large range of factors (sometimes interrelated) which can influence deposition, including:

- Rate and magnitude of tectonic activity,
- History of fault activity within the basin (including subsidence and uplift history (e.g. Turner & Long 2008),
- Rate and magnitude of sediment production (including erosion and sediment transport and the tectonic effects on topography, particularly elevation; e.g. Bridge 2003, Bridge & Demicco 2008, Bull 2007),
- Lithological composition of the source area(s) (e.g. Critelli et al. 1997),
- Chemistry of basinal waters (e.g. Branchu et al. 2005),
- Range of depositional environments and their distribution throughout the basin (both in time and space; e.g. Rossetti & Santos Junior 2004),
- Climate (both regional and local; e.g. McQuarrie et al. 2008),
- Eustasy (e.g. Gomez & Goy 2005),
- Location of the depositional area and its distance from marine influences (i.e. continentality; McCann & Saintot 2003), and
- Volcanism (e.g. Cole & Ridgway 1993).

Thus any particular basin will have its own unique depositional architecture, and the sediments which comprise these building blocks will provide the most tangible and accessible records of the lithospheric, geographical, oceanographic and ecological developments, which occur in a specific area over a specific period of time (McCann & Saintot 2003).

As noted above, tectonic activity, on a range of scales, is a major control on sedimentary activity and in recent years there has been an increase in the number of studies, beginning with the groundbreaking synthesis of Dickinson (1974), aiming at unravelling the links between tectonic events and sedimentary response, both on a basin and intrabasinal scale. Various studies on individual basins have been carried out attempting to classify the broad patterns of sedimentation within the main basin types. Such models aim to reflect the parameters, which control sediment production and distribution within the basins, while at the same time allowing for the complexity of the depositional systems (as influenced by the factors noted above) to be integrated into the models (e.g. Busby & Ingersoll 1998).

The broad pattern of faulting within a basin is determined both by the overall geodynamic setting and by pre-existing structural weaknesses, which can strongly influence fault initiation and location. Within the basin itself, deposition results from the interaction of sediment supply, its reworking and modification by physical, chemical and biological processes as well as the availability of accommodation space. The complexity of basin models can make it difficult to fully ascertain the predominant controls of a particular tectonic setting on basin evolution. However, it is also clear that the record contained within the sediments comprising the basin fill is of prime importance for the evaluation of the tectono-sedimentary evolution of a region.

Studies aimed at integrating both deformation and deposition are of prime importance both in terms of unravelling the particular dynamics of a specific basin, but also for refining existing models. It is only through such studies, particularly integrated ones, that advances can be made in providing models able to reflect the complexity of real basins and to understand the interrelationship between sedimentary facies and tectonic activity (e.g. Stets & Schäfer, this volume). Such studies may also involve analysis of eustatic changes (e.g. Poty & Delculee, this volume), sequence stratigraphy (e.g. Schäfer, this volume), or climate (e.g. Hübner et al., this volume). In terms of deformation, analysis can reveal the evolutionary history of the basin – with neotectonics providing important information with regard to the ongoing deformational history (e.g. Reicherter et al., this volume). Additionally, sediments can also be used to reconstruct the tectonic history of a basin (e.g. Velic et al., this volume), whereas in some cases the complexity of the deformational history can only be revealed using a multidisciplinary approach (e.g. Pleuger et al., this volume).

In one of the next volumes of ZDGG, three additional papers, also derived from the Bonn meeting (see below), will be included. These papers (i.e. Ghandour et al., Keil et al., McCann & Arbues) all take sedimentary successions as a starting point, integrating the results into a broad tectonic context for the evolution of the particular region (i.e. Nile Delta, NW Pamir and Ainsa Basin, respectively). Taken together, these various studies reflect the broad approach, which typifies current trends in examining the twin themes of tectonics and sedimentation.

These papers, which appear in this issue are the outcome of a 2-day meeting „Tectonics & Sedimentation“, which was held in Bonn in February 2009. I would like to take this opportunity to thank all of those who took part in that meeting, as well as those who submitted manuscripts for this volume (and the next) and the reviewers, without whose time and efforts it would have been impossible to present the current selection.

Tom McCann, Bonn

References

Branchu, P., Bergonzini, L., Delvaux, D., De Batist, M., Golubev, V., Benedetti, M. & Klerkx, J. (2005): Tectonic, climatic and hydrothermal control on sedimentation and water chemistry of northern Lake Malawi (Nyasa), Tanzania. – J. African Earth Sci., 43: 433–446, Oxford (Pergamon).

Bridge, J.S. (2003): Rivers and floodplains. Forms, processes and sedimentary record: 504 p., Oxford (Blackwell).

Bridge, J.S. & Demicco, R.V. (2008): Earth surface processes, landforms and sediment deposits: 815 p., Cambridge (Cambridge Univ. Pr.).

Bull, W.B. (2007): Tectonic geomorphology of mountains: 319 p., Oxford (Blackwell).

Busby, C. & Ingersoll, R. (1998): Tectonics of sedimentary basins: 580 p., Oxford (Blackwell).

Cole, R.B. & Ridgway, K.D. (1993): The influence of volcanism on fluvial depositional systems in a Cenozoic strike-slip basin, Denali fault system, Yukon Territory, Canada. – J. Sediment. Res., 63: 152–166, Tulsa (Soc. Sediment. Geol.).

Critelli, S., Le Pera, E. & Ingersoll, R.V. (1997): The effects of source lithology, transport, deposition and sampling scale on the composition of southern California sand. – Sedimentology, 44: 653–671, Oxford (Blackwell).

Dickinson, W.R. (ed.) (1974): Tectonics and sedimentation. – Soc. Econ. Paleontol. Mineral., Spec. Publ., 22: 204 p., Tulsa (SEPM).

Gomez, J.J. & Goy, A. (2005): Late Triassic and Early Jurassic palaeogeographic evolution and depositional cycles of the Western Tethys Iberian platform system (Eastern Spain). – Palaeogeogr., Palaeoclimatol., Palaeoecol., 222: 77–95, Amsterdam (Elsevier).

McCann, T. & Saintot, A. (eds.) (2003): Tracing tectonic deformation using the sedimentary record. – Geol. Soc. London, Spec. Publ., 208: 1–28, London (Geol. Soc. London).

McQuarrie, N., Ehlers, T.A., Barnes, J.B. & Meade, B. (2008): Temporal variation in climate and tectonic coupling in the central Andes. – Geology, 36: 999–1002, Boulder (Geol. Soc. America).

Rossetti, D.F. & Santos Junior, A.E. (2004): Facies architecture in a tectonically influenced estuarine incised valley fill of Miocene age, northern Brazil. – J. South American Earth Sci., 17: 267–284, Oxford (Pergamon).

Turner, E.C. & Long, D.G.F. 2008: Basin architecture and syndepositional fault activity during deposition of the Neoproterozoic Mackenzie Mountains Supergroup, Northwest Territories, Canada. – Canadian J. Earth Sci., 45: 1159–1184, Ottawa (NRC Research Pr.).