



Mélanges - Processes of formation and societal significance, edited by John Wakabayashi & Yildirim Dilek, 2011. GSA Special Paper 480. The Geological Society of America (order through www.geosociety.org/bookstore/). Paperback, 277 pages. Price USD 90.00 (members GSA 63.00). ISBN 978-0-8137-2480-5.

Most appropriately, a 'descriptive definition' of mélanges starts the Introduction of this book: "Mélanges occur widely in collisional and accretionary orogenic belts around the world and represent mappable geological units consisting of blocks of different ages and origin, commonly embedded in an argillitic, sandy, or serpentinite matrix showing high strata disruption and a chaotic internal structure". The term 'mélange' was first used in 1919 by a British geologist, Edward Greenly, for the Gwna Group in Anglesy, N Wales. The controversy on the definition and formation of mélanges (sedimentary vs. tectonic) has been long debated and is "livelier than ever in present time", requiring better communication among the mélange researchers. This inspired the editors to organize a topical session on mélanges during the Geological Society of America (GSA) 2007 Annual Meeting in Denver. The session was attended by scientists from North America, Europe and the circum-Pacific countries, and provided an excellent forum to discuss new advances on the mélange concept and on mélange-forming processes, based on some case studies.

The book under review emanated from this GSA topical session. An earlier GSA Special Paper (Raymond, 1984) was also devoted to mélanges; the new volume includes new subjects, new methodologies and has a more international focus. The editors of the book stress in their introduction to this book the significance of mélanges in documenting the tectonic evolution of mountain belts. Apart from the Introduction, the book comprises 13 original contributions, all based on field studies but spanning a wide spectrum of features and focus. The chapters have been grouped into Parts I-IV. The Introduction gives a summary of the various chapters and concludes with some general statements concerning mélanges.

Part I (Mélange generation in oceanic fracture zones in abyssal settings) comprises two chapters. Shervais et al. deal with the origin of mélanges with a serpentinite matrix, based on their study of the Tehama-Colusa mélange that underlies the Coast Range ophiolite in northern California where - as they argue - the proto-Franciscan subduction zone nucleated on a large offset transform fault/fracture zone that subsequently evolved into a subduction-zone mélange complex. The methods applied there, including field, petrological and geochemical observations, can be used to study mélanges with a serpentinite matrix worldwide; their origin can thus more clearly be assessed. Saleeby, based on a case study of the Kings-Kaweah ophiolite belt in California, provides evidence for subduction initiation along an abyssal fracture zone. Evidence comes from approximately 255-Ma HP/HT metamorphism of Grt-amphibolite blocks in a mélange with a serpentinite matrix. The emplacement of these blocks was related to serpentinite diapirism through the upper plate of the subduction system, as argued by Saleeby.

Part II (Mélange formation associated with subduction initiation) is a topic evaluated also in two chapters. Myhill presents a detailed metamorphic-petrologic study of Greek ophiolites and argues that the metamorphic soles, which are thin high-grade metamorphic sheets commonly found beneath ophiolites, were formed at high temperature and low pressure and that they are, consequently, not necessarily associated with subduction initiation as has been widely assumed. Mori et al., using field observations combined with petrologic and geochronologic evidence, interpret the complex tectonic evolution of the Manioca ophiolite mélange in central Japan. A subduction-initiation event led to this early HP/HT event according to these authors.

Part III (Mélange development in subduction-accretion complexes and in collisional settings) comprises eight contributions. Wakabayashi (Chapter 5) subdivides the Franciscan Complex into distinct structural groups: early mélange formed at subduction initiation, and subsequent bodies related with megathrust horizons. He also provides evidence for exhumed 'two-cycle' HP blueschist facies rocks.

In Chapter 6, Dangerfield et al. give structural and petrological evidence for an SSZ affinity of the Eldrian ophiolite and its subsequent inclusion into the Ankara Mélange as an oceanic block. In Chapter 7, by Erickson, a Cretaceous olistostrome in the Franciscan Complex is presented with field, petrological and geochronological constraints on its deposition and exhumation conditions and ages. A sedimentary re-working of blueschist-facies rocks and their subsequent metamorphism is demonstrated in this study.

Osozawa et al. (Chapter 8) and Ueno et al. (Chapter 9) deal with structural features and with the genesis of excellently exposed mélanges and related accretionary complex rocks in Japan, providing interesting details about their evolution. Festa (Chapter 10), in his structural study of mélanges from the Piedmont Basin in NW Italy, provides evidence that enables distinguishing between mélanges formed by tectonic processes, sedimentary sliding and diapiric emplacement; the different mélange types are related to regional tectonic developments according to Festa.

In Chapter 11, Muraoka & Ogawa give structural evidence from the Shikura Group mélanges in Japan for their formation in a trench-fill environment. Michiguchi & Ogawa (Chapter 12) examine the internal structure of an accretionary prism complex from the same area in Japan and show that dark bands found in siltstones originated due to various deformation mechanisms in an accretionary prism toe and in the region of the frontal thrust.

Part IV (Significance of mélanges for engineering and applied geology) consists of a single contribution by Madley & Zekkos (Chapter 13). These authors deal with engineering aspects of these heterogeneous rocks; both theory and important practical issues are discussed.

The book contains several new scientific achievements, which the editors summarize as follows.

- (1) General comments address the problem of a detailed classification and of definitions of mélanges and their subtypes. The need of a uniform classification scheme is obvious, but one should be careful in establishing such a scheme, in particular when genetic significance is attached to the definition. Consequently, descriptive rather than genetic classification schemes are recommended and the various authors therefore define mélange, in a wide sense, as a bedrock unit with a variety of blocks included in a matrix.
- (2) Whether mélanges originate from sedimentary or tectonic mixing is still under discussion for many particular examples. Increasing evidence from many case studies shows that even the most sheared mélanges must have formed due to a significant contribution of sedimentary mixing.
- (3) Mélanges are characteristic features of convergent plate boundaries and play a significant role in the reconstruction of the development of orogenic belts, which form critical records of the processes affecting convergent-plate margins in accretionary prisms and fore-arc basins. They can also form in other environments such as along abyssal fracture zones, however.
- (4) Mélanges are, due to their chaotic block-in-matrix structure, strong internal deformation and high clay content, prone to landsliding. Engineering projects should therefore pay adequate attention to the hazards that mélanges pose.

In summary, mélanges still remain an important target for further research that should provide both theoretical advantages and results that are of significant practical geo-engineering importance. This is not a systematic handbook but a collection of the results of case studies regarding a wide spectrum of problems connected with the formation and development of mélanges in various environments. They contribute significantly to our knowledge of mélanges and their importance in the paleotectonic reconstruction and interpretation of orogenic systems. These new achievements should help delineate future studies.

I can recommend this book to all those who work on these intriguing rocks as well as to a wider geological community interested in global tectonic processes, paleotectonic and paleogeographic reconstructions and the interpretation of orogenic belts. It should be available in the all academic earth-science libraries.

Reference

Raymond, L.A. (ed.), 1984. Mélanges: their nature, origin, and significance. GSA Special Paper 198. Geological Society of America, Boulder.

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