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Mélange Types and Tectonic Settings of Their Formation

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We present a comparative analysis of on-land examples of ancient mélanges and diverse modern tectonic environments where mélange-forming processes are currently operating, and discuss: (1) possible relationships between the mélange types and their tectonic setting of formation; (2) contribution of mass-transport versus contractional deformation processes at the onset of mélange formation, and (3) nature of the continuum and transition from broken formations to true tectonic mélanges. We propose a preliminary subdivision and classification of mélanges associated with extensional, strike-slip, convergent margin and collisional tectonics, and passive margin evolution and intra-continental deformation.

The internal structure and the regional geology of different mélanges indicate that a close relationship exists between the mélange types and their tectonic setting of formation. Mélanges forming in rift-related extensional, passive margin, and open-ocean settings are generated mainly by gravity-induced sedimentary processes (i.e. mass-transport), which are commonly triggered by tectonic activities; however, direct contribution of extensional processes, such as crushing and mixing in normal fault zones, are negligible during the formation of these mélanges. Tectonic mélanges, whose fabric elements and structures are caused by contractional tectonic events alone, develop mainly along the base of accretionary wedges, such as along the main décollement zone, within subduction channels, in the lower plate below the main décollement surface, and within the zones of underplating in subduction-accretionary wedges. Zones of protracted offscraping and stacking of thrust faults, out-of-sequence thrusting, nappe imbrication (mostly in the case of high-P & T metamorphic mélanges), and strike-slip faulting in collisional orogens are primary locations of tectonic mélange formation. Tectonic mélanges are commonly subordinate to broken formations, and are spatially restricted to narrow, elongated to coalescent fault zones, large-scale fault zones, and/or plate boundaries. Sedimentary mélanges are associated mainly with rift-related extensional tectonic and passive margin settings, and are commonly found at the base, within and above the shallowest nappes in intra-continental deformation zones of the ancient submarine collisional orogens. In contrast, the conditions that are necessary for the formation of diapiric mélanges are easily reached in different geological environments, where both tectonic and sedimentary mélanges may form. Diapiric mélanges are not strictly related to a particular tectonic setting but rather to particular physical and mechanical conditions. This phenomenon also explains as to why diapiric mélanges commonly represent the reactivation of deep-seated olistostromes and/or water-rich tectonic and/or tectono-sedimentary mélanges.