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Application of heavy minerals analysis in studies of tsunami deposits

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Tsunami deposits are very important for assessment of tsunami hazard. However, their identification is often difficult because they are depended on many factors and there is no unique set of features, which could be applied. The presence of heavy minerals (HM) have been frequently noted in tsunami deposits, however, so far they were little studied in detail. The HM analyses may be useful in finding the sediment provenance (e.g. marine), and trends (vertical and spatial) in HM assemblages within the tsunami deposits resulting from hydraulic sorting processes that had been acting during the tsunami. To test usefulness of HM analysis in tsunami deposits studies the modern tsunami deposits left by 2004 Indian Ocean tsunami on Kho Khao Island, Thailand (details in Jagodziński et al. 2009), and by 2011 Tohoku-oki tsunami on Sendai plain, Japan, were studied. The HM fraction content and mineral assemblages significantly differs between the two studied cases. Tsunami deposits from 2004 tsunami contained only $\sim$ 1.7 % of HM and 99 % of them were tourmalines, micas, limonites, zircon and opaque minerals. The Tohoku-oki tsunami deposits were composed on average in 34 % from HM. They were in 97 % represented by amphiboles, pyroxenes and opaque minerals. The HM assemblages of 2004 tsunami were different from beach sediments and pre-tsunami soils, and were partly derived from marine sediments. Moreover, observed variations within HM suit, in particular in share of flake-shaped micas, reflected sedimentation from suspension by particular waves. The HM analyses of Tohoku-oki tsunami deposits revealed no significant difference between tsunami deposits, beach sediments and pre-tsunami soils. It suggested that the contribution of marine sediments may be very small, as suggested also by micropaleontological studies. There is also no regular trend within tsunami deposits apart from steady landward decrease of HM fraction content. The HM analysis may be useful supplementary tool in tsunami deposits studies, however, the interpretation must be always put in local geological context and faced against other "tsunami proxies" (e.g. diatoms).

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