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Facies-related fracturing in turbidites: insights from the Marnoso-Arenacea Fm. (Northern Apennines, Italy)

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Natural fractures deeply influence subsurface fluid flow, exerting a primary control on resources like aquifers, hydrocarbons and geothermal reservoirs, and on environmental issues like CO_2 storage and nuclear waste disposal. In layered sedimentary rocks, depositional processes-imprinted rock rheology favours the development of both mechanical anisotropy and heterogeneity on a wide range of scales, and are thus expected to strongly influence location and frequency of fractures. To better constrain the contribution of stratigraphic, sedimentological and petrophysical attributes, we performed a high-resolution, multidisciplinary study on a selected stratigraphic interval of jointed foredeep turbidites in the Miocene Marnoso-arenacea Formation (Northern Apennines, Italy), which are characterised by a great lateral and vertical variability of grain-size and depositional structures. Statistical relationships among field and laboratory data significantly improve when the single facies scale is considered, and, for similar facies recording different evolutionary stages of the parent turbidity currents, we observed a direct correlation between the three-dimensional anisotropies of rock hardness tensors and the normalized fracture frequencies, testifying for the primary sedimentary flow-related control on fracture distributions.