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Sediment mobilization deposits from episodic subsurface fluid flow—A new tool to reveal long-term earthquake records?

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Subsurface fluid flow can be affected by earthquakes: increased spring activity, mud volcano eruptions, groundwater fluctuations, changes in geyser frequency and other forms of altered subsurface fluid flow have been documented during, after, or even prior to earthquakes. Recently discovered giant pockmarks on the bottom of Lake Neuchâtel, Switzerland, are the lake-floor expression of subsurface fluid flow. They discharge karstic groundwater from the Jura Mountains and experience episodically increased subsurface fluid flow documented by subsurface sediment mobilization deposits at the levees of the pockmarks. In this study, we present the spatio-temporal distribution of event deposits from phases of sediment expulsion and their time correlative multiple mass-transport deposits. We report striking evidence for five events of concurrent multiple subsurface sediment deposits and multiple mass-transport deposits since Late Glacial times, for which we propose past earthquakes as trigger. Comparison of this new event catalogue with historic earthquakes and other independent paleoseismic records suggests that initiation of sediment expulsion requires a minimum macroseismic intensity of VII. Thus, our study presents for the first time sedimentary deposits resulting from increased subsurface fluid flow as new paleoseismic proxy. Comparable processes must also be relevant for other mountain front ranges and coastal mountain ranges, where groundwater flow triggers subsurface sediment mobilization and discharges into lacustrine and marine settings.