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Experimental initiation of fluid venting structures in unconsolidated granular and cohesive sediments

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Focused outflow of water at the seafloor, termed seepage or fluid venting, is a widely recognized global phenomenon. In an effort to better understand the mechanisms by which fluid flow-related structures form, we performed laboratory seepage experiments using samples representing a broad range of grain sizes and hydraulic conductivities (10E−3 to 10E−8 m/s). Detailed observations led to the recognition of a typical, often-repeated progression of fluid flow structures that form during processes of increasing and decreasing hydraulic gradients. The development of fluid flow structures like macro-pores, conduits, and pipes is strongly dependant upon cohesion but is unrelated to grain size variations from sample to sample. Partial liquefaction leads to permanent changes in the grain fabric and to an increase in hydraulic conductivity. Our observations explain the longevity of seep sites and systematic relationships between hydraulic gradients, grain fabric appearance, and hydraulic conductivity that could be used to estimate flow rates based on structural findings.