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Failure surface development due to shallow gas: A case study from the Hikurangi Margin, New Zealand

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The characteristic morphology of spreading, in the form of a recurring and parallel pattern of ridges and troughs, has been observed in numerous submarine landslides around the world. Limit equilibrium modelling of slope failure processes in the Storegga Slide had indicated that an increase in pore pressure is likely an important cause of spreading. In this study we explore the hypothesis that pore pressure generation in sub-seafloor sediments by shallow gas can promote the development of a weak layer above which submarine spreading can occur. We do this by analysing multibeam echosounder, sub-bottom and 2D multichannel seismic data acquired offshore the east coast of the North Island, New Zealand. Using these data we are able to identify spreading morphologies in thin, gently-dipping, parallel-bedded clay, silt and sandy sedimentary units deposited as lowstand clinoforms. More importantly, a sharp, coherent, high-amplitude seismic reflector, which we interpret as the top of an accumulation of gas within the porous sediments, occurs extensively in the shallow sediments of the upper continental slope, but not where the spreads are located. This indicates that shallow gas has played a key role in establishing the failure surface. Seismic loading and fluctuations in sea level are proposed as the factors that could have triggered changes in sediment pore pressure.