Correlations among seabed mega pockmark size, water depth, and gas volumes suggest formation by depressurization: A case study of the Reed Basin in the South China Sea

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Pockmarks are relict seafloor geomorphological features formed by seepage of gas or fluid from the seabed. While seafloor pockmarks are widely distributed around the world, mega pockmarks with diameters > 1 km are rare, and their formation and maintenance mechanisms remain enigmatic. Using high-resolution multi-beam bathymetric data, this paper systematically identified mega pockmark groups in the southern depression of the Reed Basin in the South China Sea. Mega pockmarks of various shapes occur in groups in the Reed Basin, primarily along the sides of submarine canyons. Observed geomorphologic characteristics differ significantly from features reported in the published literature. Based on the collected data, the average ratio of pockmark depth to pockmark radius ($d/r$) is evaluated as ~0.3, which is consistent with analyses of additional pockmarks in 21 regions around the world. Our observations also agree with the previously reported generalization that small pockmarks are developed in shallow water and large pockmarks in deep water. We propose that pockmarks in the Reed Basin are formed by seafloor gas explosions. Widely developed carbonates store buried gas that continuously seeps along NE-SW trending faults. Cap layers are undercut by submarine canyons forming lines of mechanical weakness. During periods of rapid sea level fall, depressurization causes buried gas to be rapidly ejected along these lines, forming large pockmark groups. Because these results correlate easily observed bathymetric features to the presence of buried gas deposits, they have important implications for the exploration and research of deep-sea gas resources.