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Gas hydrates, free gas distribution and fault pattern on the West Svalbard continental margin

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A three dimensional tomographic analysis of seismic velocity and attenuation fields is presented with the purpose to analyze the intimate relation of gas hydrates and free gas distribution with the fault pattern. The 3-dimensional, 4-component seismic data have been acquired offshore western Svalbard. The analysis of the sub-bottom topography of the base of the stability field of gas hydrates (indicated by the Bottom Simulating Reflector) and the thickness of the free-gas bearing zone below it suggests a fault-induced compartmentalization of the gas reservoir. The proposed fluid and gas circulation scheme assumes deep sourced warm fluids moving upwards mainly along high permeability faults and fractures below the gas-hydrate stability zone. Faults change from being a pathways of fluid flow (below the hydrate stability zone) to being barrier to fluid flow in the hydrates stability zone. Consequently, below the hydrates stability zone free-gas is transferred from the permeable faults to non-faulted (but fault-bounded) sediments, where it accumulates below the base of the hydrate stability zone, determining a significantly thicker free-gas layer. The tomographic approach is therefore proposed as an effective procedure to provide detailed information on 3-D P- and S-wave velocity and attenuation distribution revealing fluid spatial/temporal changes in the host rocks and their relation with the fracture system.