Geophysical Research Abstracts
Vol. 13, EGU2011-4178, 2011
EGU General Assembly 2011
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Using BSRs to Estimate Spatial Variations of Vertical Fluid Flow Rates in Offshore Taiwan Accretionary Prism

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Fluid flow rates are important for understanding gas hydrate systems under the seafloor. However, such information is difficult to derive. Here we propose to use bottom-simulating reflectors (BSRs) offshore Taiwan accretionary prism to estimate fluid flow rates. Offshore Southern Taiwan, there is a wide spread of BSRs, which marks the base of the gas hydrate stability zone in this region. We have mapped more than 500,000 of BSRs in this region using more than 12,000 km of seismic profiles. This dense seismic dataset covers most of the Taiwan accretionary prism. Using seafloor depth and BSR subbottom depth, we can estimate the hydrostatic pressure at the BSR, which is then applied to the methane hydrate phase diagram to derive the temperature at the BSR. For a region, we usually find multiple and varying BSR subbottom depths, thus we can derive BSR-based temperature profiles at different subbottom depths. We apply Peclet analysis using such depth-varying geothermal gradient profile to estimate a 1D vertical fluid flow rate. We have conducted such analyses in many parts of the Taiwan accretionary prism from subduction to collision zones. We found that near the trench axis, there is stronger vertical upward fluid migration in the collision zone than in the subduction zone, possibly due to more extensive deformation, and thus dewatering in the collision zone where the thick Chinese passive margin enters into the convergent boundary, especially near canyons and slumped regions. The preliminary results are consistent with patterns observed in the geochemistry data. Similar studies can be conducted using BSRs from other regions, which can give a first-order regional-scale vertical fluid flow patterns.