

Fig. 5. Seafloor temperature at various water depths in the Gulf of Oman. Data provided by the Marine Information and Advisory Services of the Institute of Oceanographic Sciences (Minshull and White, 1989).

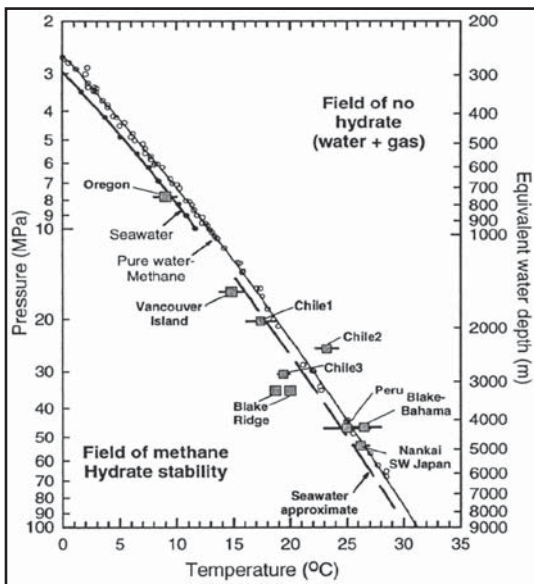


Fig. 6. The pressure-temperature phase diagram for the methane gas-hydrates stability field. The solid line is the seawater curve from the equation-of-state computation for artificial seawater (Dickens and Quinby-Hunt, 1994; Englezos and Bishnoi, 1988). BSR temperatures in DSDP-ODP drill holes are also indicated (Ganguly et al., 2000).

Thermal Conductivity

The thermal conductivity of an n-component system is generally expressed as (Grevemeyer and Villingner, 2001)

$$K = \prod_{i=1}^n K_i^{v_i} \quad (9)$$

where, K_i and v_i are the conductivity and volume percent of the i^{th} component. Using equation (9) we can derive the background thermal conductivity-depth function from the porosity-depth function using the relation between porosity and thermal conductivity K_s as

$$K_s = K_m^{(1-\phi)} K_w^{\phi} \quad (10)$$

where, K_m and $(1 - \phi)$ are volume fraction of water and the

matrix in the sediment respectively and K_w and ϕ are 2.5 and 0.6 W/m/K, representing the thermal conductivities of the matrix and water respectively. The value of K_m was obtained by taking the best-fitting geometric mean of matrix conductivities of unconsolidated sediments from several continental margins of the world (Grevemeyer and Villingner, 2001).

The thermal conductivity of the hydrated sediment, K_h , in the depth interval between 285 to 495 m below seafloor can be similarly determined as

$$(11)$$

where K_h ($=0.4$ W/m/K) represents the thermal conductivity of pure hydrates.

Using equations (10), we calculate the background thermal conductivity and the associated error bounds (Figure 7) as a function of depth below the seafloor. The thermal conductivity of the hydrated sediment calculated using equation (11) is also shown by dotted-dashed lines in Figure 7. We see that the thermal conductivity of hydrated sediments decreases with respect to the background trend. The average thermal conductivity of the sedimentary formation and hence the heat flow are calculated as 1.267 W/m/K and 43.55 mW/m² respectively. The estimated values match quite accurately with the published results of 1.27 W/m/K and 43 mW/m² for thermal conductivity and heat flow respectively near the study area (Grevemeyer and Villingner, 2001; Kaul et al., 2000).

The K_m lower and K_h upper bounds in thermal conductivity and heat flow are calculated as 1.2 W/m/K and 41 mW/m², and 1.34 W/m/K and 46 mW/m² respectively.

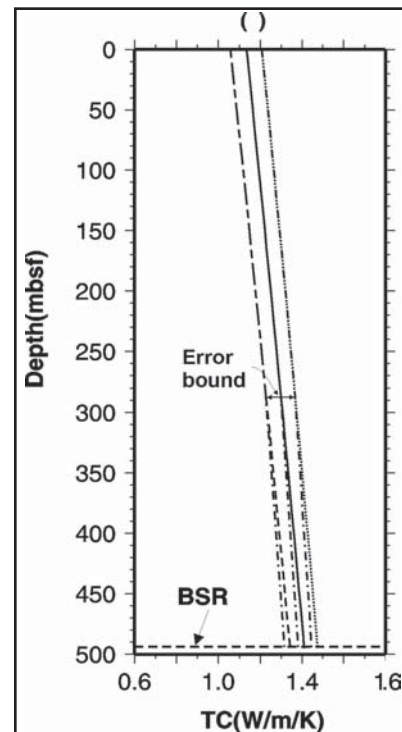


Fig. 7. Background thermal conductivity versus depth along with the lower- and upper-bounds. The thermal conductivity variation of hydrated sediment is also shown.