FIELAX HeatFlowProbe

The FIELAX HeatFlowProbe is a scientific device to measure in-situ thermal gradients and thermal conductivities of marine sediments, from which the heat flux density can be determined. The FIELAX HeatFlowProbe is an enhanced version of the Heat Flow Probe developed by the Department of Geosciences, Bremen University (Prof. H. Villinger) in the course of “Gas Hydrates” investigations. Adapted to market needs in size and handling, FIELAX GmbH offers the possibility to purchase or rent the HeatFlowProbe combined with scientific/technical service for expeditions and/or data processing.

What are the benefits of heat flow measurements?

- Heat flow measurements yield important boundary conditions for sedimentary basin modeling and supplies information on fault zones and fluid flow
- Heat flow aids in maturity calculation for oil and gas exploration and enables stability analysis of gas hydrate deposits
- Thermal conductivity data provide essential information regarding technical and environmental aspects for power cable burial

Deployment and operation

- Maximum penetration depth of 6 m is essential for optimal cable burial depth determinations and geothermal gradient estimations independent of seasonally influenced sediment layers
- Penetration depth depends mainly on the type of sediment and may be adjusted by additional weights
- ‘Pogo-Style’ operation (probe remains lowered at depth during transit) minimizes station time

FIELAX provides

- Purchase or rental of the FIELAX HeatFlowProbe
- Experienced operators in heat flow exploration
- Processing and interpretation of heat flow data

Selected references: WeserWind GmbH Offshore Construction Georgsmarienhütte, HOCHTIEF, NGU, Ifremer, OSAE, Universität Bremen, GEUS, HRT Petroleum, BARD, ipex, 50hertz, REEDEREI F. LAEISZ, AWI, IOW, Umwelt Bundes Amt, reoxn, TDI Brooks, HYUNDAI Heavy Industries Co., Ltd., Sandbank Power GmbH & Co. KG, AREVA, MULTIBRID, FUGRO, GFZ Potsdam, CSIC, Max Planck Institute for Marine Microbiology, IFM-GEOMAR

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Processing of heat flow data

Figure 1 shows a typical plot of thermistor readings versus time. During penetration (approx. Sec 0 – 100), temperature is rising due to frictional heating and convergence towards sediment temperatures. After 7 minutes (sec. 420), a defined heat pulse is released and the heat is allowed to dissipate until equilibrium is reached resp. is sufficiently approximated.

Figure 2 (left) shows the thermal gradient (temperature versus depth) derived from temperature approximations around sec. 400 from Figure 1. The right side of Figure 2 depicts the depth-dependent thermal conductivities derived from heat pulse thermal decay.

Figure 3 (Bullard Plot) compares integrated thermal resistance with temperature. The interpretation of this data allows to decide whether heat flow is purely conductive (linear relationship) or whether other mechanisms like advection are involved. The latter would point to, for example, fluid flow processes.

Figure 4 shows temperature profiles across a gas hydrate reservoir. Profiles ‚Pen 3' and ‚Pen 4' show strong deviations from linear depth dependence indicating enhanced advection processes.

Technical Facts of the FIELAX HeatFlowProbe

- Total length 7.7 m, up to 6 m penetration depth weight 1000 kg
- Additional weight up to 3000 kg
- Containerized dimensions
- Operational up to 6000 m water depth
- Sensor string with 22 temperature sensors
- Range -2° C to 60° C, resolution < 1 mK, accuracy +/-2mK
- Sampling frequency 1 Hz
- Power pack, data acquisition and autonomous control integrated in the probe, online or memory-based data recording
- Autonomous and online control modes
- Quality check and online data evaluation with deck unit

FIELAX HeatFlowProbe Survey Experience

- 2015 Fugro AG Pty Ltd, Australia: O&G exploration for Statoil, Offshore Australia
- 2014 MG3, UK: O&G exploration for Total, Arabian Sea
- 2013 Marine Sampling Holland, Netherlands: Cable route survey for elia, English Channel
- 2013 GEMS, Colombia: O&G exploration for Ecopetrol, Offshore Colombia
- 2012 SEARIE, Malaysia: O&G exploration for NOEX, South China Sea
- 2011 Fugro Consult GmbH, Germany: Cable route survey, North and Baltic Sea
- 2010 Gardline Ltd, UK: O&G exploration for ExxonMobil, Black Sea

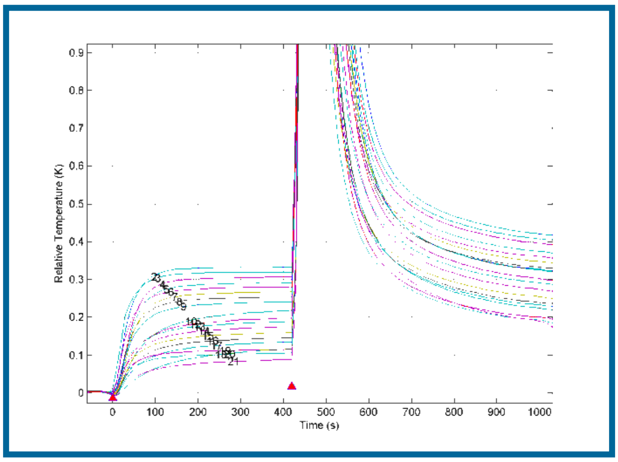

Figure 1: Temperature recording

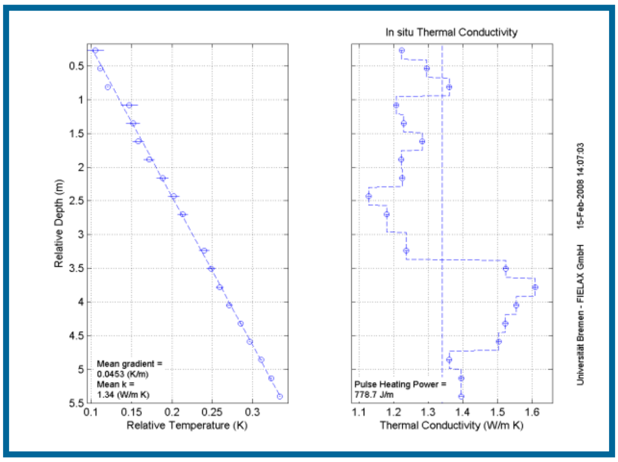

Figure 2: Temperature and conductivity vs. depth

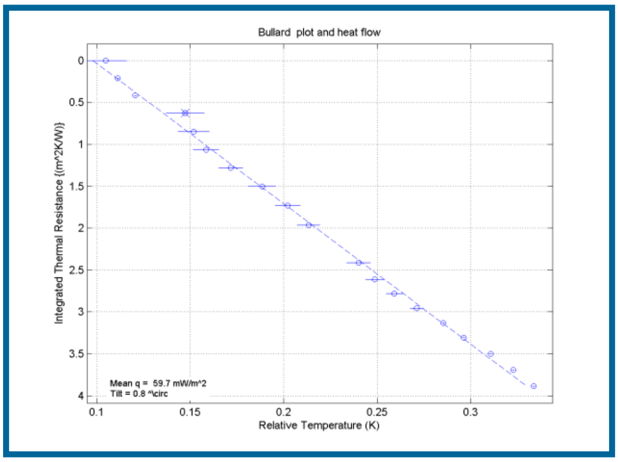

Figure 3: Thermal resistance vs. temperature

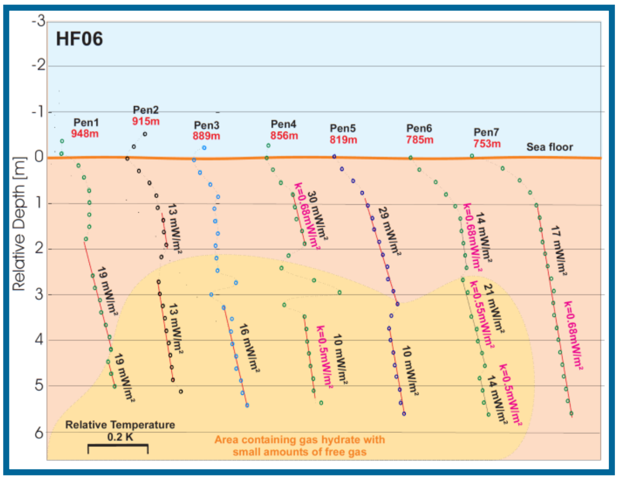

Figure 4: Temperature profiles across gas hydrates