FIELAX VibroHeat

FIELAX
Gesellschaft für wissenschaftliche Datenverarbeitung mbH

For in-situ temperature and thermal conductivity measurements in shear resistant marine sediments, typical for shallow seas, coastal and continental shelf regions, FIELAX GmbH combined the functional components of the FIELAX HeatFlowProbe with a VKG6 type Vibrocorer. We name this new measuring device “VibroHeat”. With the ability to penetrate even through harsh layers such as gas hydrates, permafrost soils or “sands”, the technical application is not restricted to soft sediment conditions anymore.

What are the benefits of heat flow measurements using the new VibroHeat?

- Heat flow measurements with the original HeatFlowProbe yields important boundary conditions for sedimentary basin modeling and supplies information on fault zones and fluid flow, but due to its design it is restricted to deep water applications
- The new VibroHeat system allows the acquisition of thermal conductivity data even in shallow water regions providing essential information regarding technical and environmental aspects for e.g. power cable burial
- Time and cost efficient it allows combining the recovery of sediment cores and the acquisition of thermal conductivity profiles in one go

>> Unique, new method to measure in-situ thermal conductivities for cable routes

Deployment and operation

- Maximum penetration depth of 5,5 m is essential for optimal cable burial depth determinations and geothermal gradient estimations independent of seasonally influenced sediment layers
- A defined heat pulse is released into the sediment, through which it is possible to determine the thermal conductivity of the sediment
- VibroHeat can be operated on small vessels in water depths up to 200 m

FIELAX provides

- Full campaign service with HeatFlowProbe and VibroHeat
- 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, CSIC, IOW, Umwelt Bundes Amt, GEOXH, TDI Brooks, Sandbank Power, Areva Multibrid, Fugro, GFZ Potsdam, 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 respectively is sufficiently approximated.

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

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 VibroHeat device

- Up to 5,5 m penetration depth
- Optimized for shallow water operations up to 200 m water depth (e.g. North Sea or Baltic Sea)
- Containerized dimensions
- Sensor string with 22 temperature sensors
- Range -2°C to 60°C resolution < 1 mK, accuracy +/-2mK
- Sampling frequency 1Hz
- Power pack, data acquisition and autonomous control integrated on the head of the Vibrocorer, online or memory based data recording.
- Autonomous and online control modes
- Quality check and online data evaluation with deck unit

FIELAX HeatFlowProbe Survey Experience

- 2011 Fugro Consult GmbH, Germany: Cable survey, North Sea
- 2010 50Hertz Transmission GmbH, Germany: Shallow water cable survey, Baltic Sea
- 2010 Gardline Marine Science Ltd, UK: O&G exploration for ExxonMobil, Black Sea
- 2009 HRT Petroleum, Brazil and GEMS, Colombia: O&G exploration for Ecopetrol off Colombia
- 2008 RV Poseidon cruise P362/2 and RV Sonne cruise SO195
- 2007 IfM GEOMAR, Germany: O&G exploration for DEA, West Niledelta
- 2006 GEUS, Denmark: Geothermal investigation of hydro-carbon bearing basins off West Greenland
- 2005 RV Meteor cruise M66/3b: Deep water exploration off Nicaragua and Costa Rica (> 4000 m)

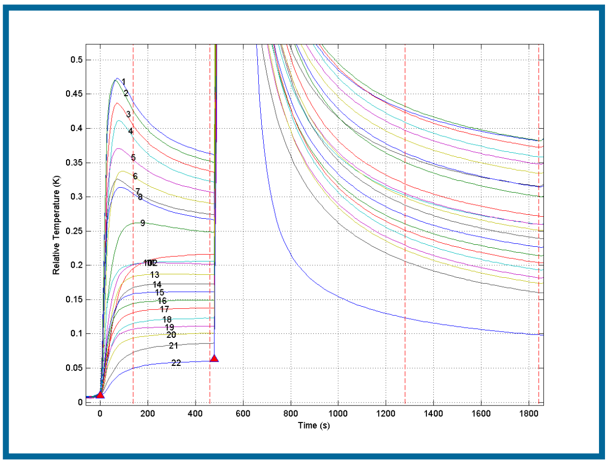

Figure 1: Temperature recording

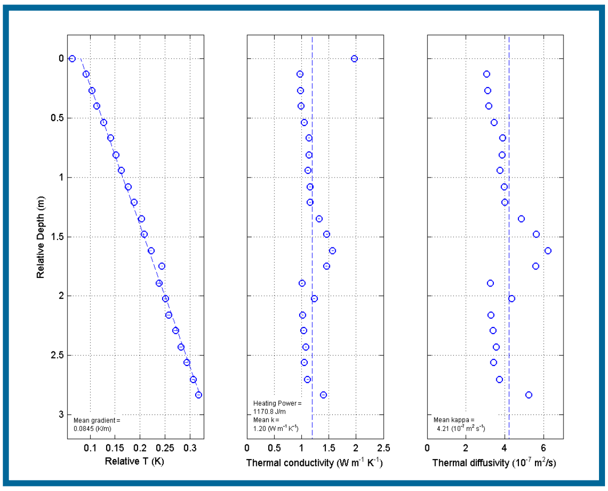

Figure 2: Temperature and conductivity vs. depth

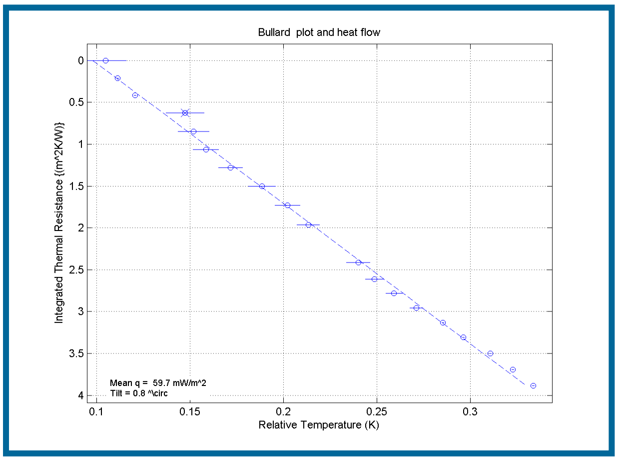

Figure 3: Thermal resistance vs. temperature

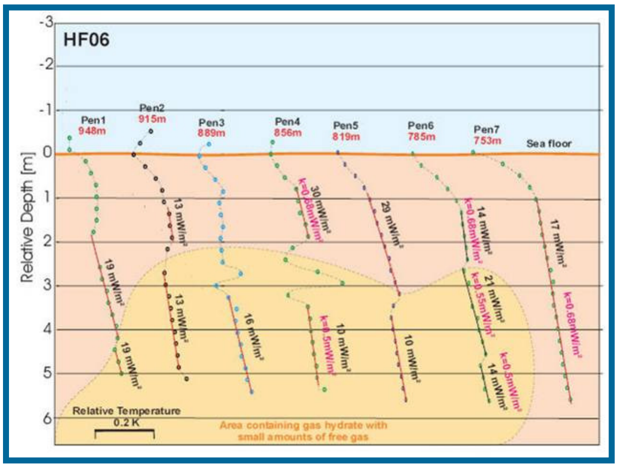

Figure 4: Temperature profiles across gas hydrates