



## FIELAX VibroHeat

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

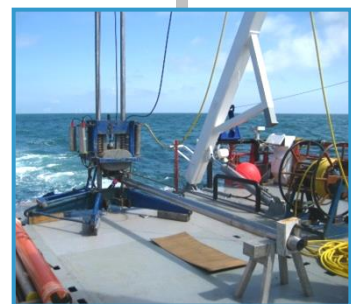
**>> Unique, new method to measure in-situ thermal conductivities for cable routes**

### 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:



### FIELAX

Gesellschaft für wissenschaftliche Datenverarbeitung mbH

Schleusenstr. 14  
D-27568 Bremerhaven

GERMANY

Fon +49 (0)471 30015-0  
Fax +49 (0)471 30015-22  
Mail info@fielax.de  
Internet www.fielax.de

## 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 from 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.

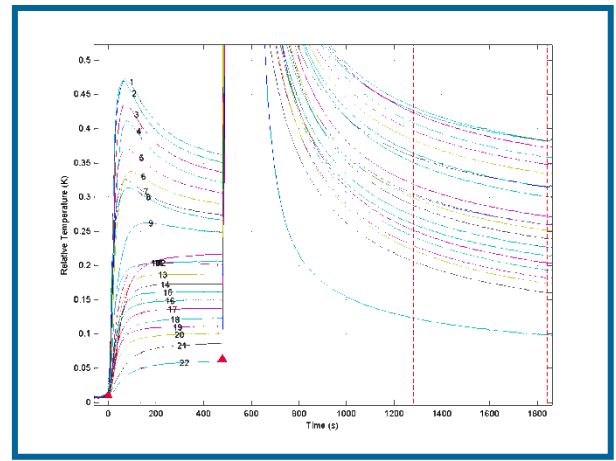
**Figure 4** shows temperature profiles across a gas hydrate reservoir. Profiles 'Pen 3' and 'Pen 4' show strong deviations from linear depth dependence indicating enhanced advection processes.

## Technical Facts of the VibroHeat device

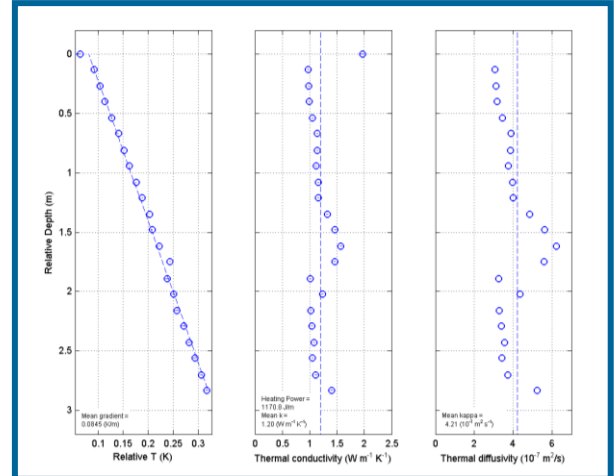
- Up to 5,5 m penetration depth
- Optimized for shallow water operations up to 200 m water depth (e.g. North Sea or Baltic Sea)
- Containerized dimensions
- Sensor string with 22 temperature sensors
- Range  $-2^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  resolution  $< 1\text{ mK}$ , accuracy  $\pm 2\text{ mK}$
- 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 VibroHeat Survey Experience

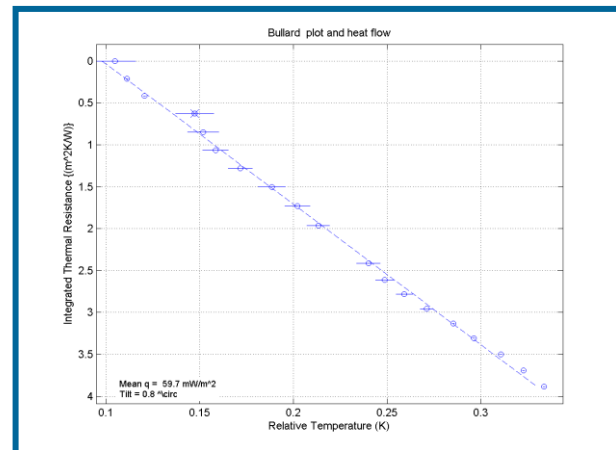
- 2015 Igeotest, Spain: Cable route survey, Gulf of Biscaye
- 2014 MMT, Sweden: Nordlink cable route survey, North Sea
- 2013 GEMS, Colombia: O&G exploration for Ecopetrol, Offshore Colombia
- 2012 Marine Sampling Holland, The Netherlands: Cable route survey for elia, English Channel
- 2011 Fugro Consult GmbH, Germany: Cable route survey for NSW, North and Baltic Sea
- 2010 50Hertz Transmission GmbH, Germany: Shallow water cable route survey, Baltic Sea



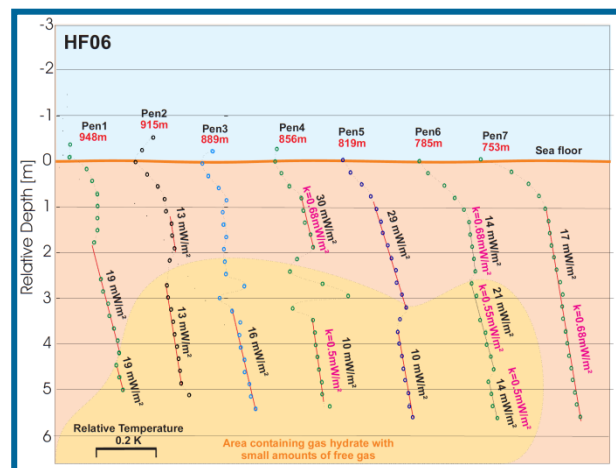
**Figure 1:** Temperature recording



**Figure 2:** Temperature and conductivity vs. depth



**Figure 3:** Thermal resistance vs. temperature



**Figure 4:** Temperature profiles across gas hydrates