Geophysical Research Abstracts, Vol. 7, 05031, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05031

Gradual Post-Drilling Destabilization of Temperature Profile by Convection in ICDP Borehole Yaxcopoil, Mexico

J. Šafanda (1), P. Heidinger (2), H. Wilhelm (2), V. Čermák (1)

(1) Geophysical Institute, Prague, Czech Republic, (2) University Karlsruhe, Germany (jsa@ig.cas.cz)

As one of the ICDP (International Continental Drilling Programme) projects, the 1.5 km deep borehole Yaxcopoil was drilled in December 2001 through February 2002 within the impact structure Chicxulub on the Yucatan peninsula, Mexico. Temperature-depth profiles obtained during four temperature loggings of the borehole in the period 2002 - 2004 display effects of a thermal fluid convection gradually propagating downward. The convective features were limited within the uppermost 145 m of the hole during the first logging campaign in March 2002, starting 10 days after shut-in of the mud circulation and the temperature was increasing linearly between 145 and 370 m with a gradient of 41 mK/m, consistent with the heat flow density observed below 400 m and with the expected thermal conductivity. The lower front of the convective section, marked by a sharp jump on the temperature curve before its connection with the linear part, had proceeded to the depth of 230 m by the time of the second logging in May 2003 (the propagation rate of 6.1 m/month). This process has been going on to the present. The third (February 2004) and the fourth (December 2004) loggings found the front at a depth of 265 m and 310 m, respectively, which means the propagation rate of 3.9 m/month and 4.2 m/month. An amplitude of the temperature jump at the front has been increasing in time from 0.8˚C at the first logging via 1.3 ˚C at the second, 1.4 ˚C at the third to 1.6˚C at the fourth logging, whereas the gradient within the jump was about 190 mK/m all the time. The temperature is generally below the initial linear curve in the depth section engulfed by a convection since the first logging. We observed directly a downward spreading of the convective front by a several day temperature monitoring in the middle of the jump in the depth of 307 m started immediately after the fourth logging. A passage of the front was marked

by cooling, the rate of which was consistent with the observed long-term propagation of the front (4 m/month) and the gradient within the jump (190 mK/m). Possible driving forces of this unusual phenomenon might be (i) a drilling disturbance of the fresh/saline water interface, initially at the depth of about 70 m, (ii) a replacement of the drilling mud, pressed into cavities of the karst during the drilling, by groundwater and/or (iii) a thermal convection induced by the large borehole diameter of 245 mm in the uppermost 400 m.