Juan De Fuca Ridge Flank CORK Temperature Logger Summary

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During IODP Expeditions 301 and 327, modified CORK-II observatories were installed in five ODP/IODP boreholes on the eastern flank of the Juan de Fuca Ridge. The CORK configurations were described in detail by Fisher et al. (2005, 2011). The downhole sensor strings for these CORKs included memory temperature loggers at various depths, with a mix of loggers manufactured by Onset Computer Corporation or Antares Datensysteme GmbH, as described in more detail in the two Fisher et al reports. The sensor strings were recovered several years after deployment, using DSRV Alvin, the ROV Jason, or D/V JOIDES Resolution. Funding for the temperature loggers and submersible operations was provided by the following National Science Foundation grants, which should be acknowledged if these data are published by future users: OCE-0400471, OCE-0550202, OCE-072687, OCE-1030350, and OCE-1260180 (KB), and OCE-0550713, OCE-0727952, OIA-0939564, OCE-1031808, and OCE-1260408 (ATF).

The appended table summarizes important key information relevant to the individual data files posted on MGDS. The files include ASCII time-series data of temperatures recorded by each logger, as converted from raw data using factory software and calibrations. For the majority of the data files, the deployment durations exceeded the nominal battery lifetimes, so the loggers shut down at some point while preserving recorded data in non-volatile memory. This meant it was not possible to check clock drift when the loggers were revitalized with external power to recover the non-volatile data. For the few loggers that were still working on recovery, clock drift appeared to be better than a few minutes per year.

Users should realize that there are a few important operational factors that produced very distinct effects in some of the data records, as follows:

(1) The CORKs in Holes U1301A and U1301B were not properly sealed when installed in 2004, and cold ocean bottom water was drawn down both holes for several years. The flow down Hole U1301A spontaneously reversed in early September 2007, as is clearly shown by the pertinent data files and figure in Wheat et al (2010).

(2) In July 2009, IODP Expedition 321T (Fisher et al, 2010) returned to Holes U1301A and U1301B to try to seal them with remedial cementing in the reentry cones. This apparently stopped the downhole flow in Hole U1301B, as is shown by the increase in downhole temperatures recorded at the time and an apparent return to conductive thermal conditions as of Expedition 327 one year later. However, the remedial cementing did not seal Hole U1301A, which continued to discharge hydrothermal fluid from the volcanic crust.

(3) During July 2011 AT18-07 submersible operations, a large-diameter ball valve on the CORK wellhead at Hole U1362B was fully opened for a flowmeter experiment, and the hole produced copious warm fluids for the next two years. Rapid upflow between 2011 and 2013 is clearly indicated in the Antares thermal records from shallow depths in Hole U1362B, as documented by Neira et al. (2016).

(4) During July 2013 AT26-03 submersible operations, the large-diameter free-flow valve on the CORK wellhead at Hole U1362A was fully opened for a flowmeter experiment, and the hole produced copious warm fluids for the next year. This is clearly registered by sudden warming of the Onset data loggers that were placed at shallow depths in the hole.

References:

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Downhole Temperature Loggers from Juan de Fuca Ridge Flank CORKs

Logger Type	**ID***	**Depth (mbsf)**	**Data recovered?****	**Filename**
Hole 1026B, basement depth = 247.1 mbsf				
Loggers deployed 2004, IODP Exp 301, recovered 2008, AT15-35				
Onset	768597	205.5	At Onset**	1026B_O786597.dat
Antares	1857005*	210.5	Did not record	
Hole U1301A, basement depth = 262.2 mbsf				
Loggers deployed 2004, IODP Exp 301, recovered 2008, AT15-35				
Antares	1857006*	266.0	Yes	U1301A_A1857006.dat
Antares	1857003*	270.8	Yes	U1301A_A1857003.dat
Onset	768595	275.5	At Onset**	U1301A_O768595.dat
Antares	1857001*	279.3	Yes	U1301A_A1857001.dat
Onset	768596	283.0	Yes	U1301A_O768596.dat
Antares	1857002	286.8	Did not record	
Loggers deployed 2009, AT15-51, recovered 2013, AT26-03				
Onset	768616	2.6	At Onset**	U1301A_O768616.dat
Antares	1857030	10.9	At Antares**	U1301A_A1857030.dat
Onset	768604	24.7	At Onset**	U1301A_O768604.dat
Onset	768598	259.7	No data. This section of sensor string was trapped by collapsed formation in open hole and broke off during AT26-03 recovery attempt in 2013.	
Antares	1857004	264.7		
Onset	768596	274.5		
Antares	1857036	283.6		
Onset	768603			
Hole U1301B, basement depth = 265.2 mbsf				
Loggers deployed 2004, IODP Exp 301, recovered 2010, IODP Exp 327				
Antares	1857010*	266.0	Yes	U1301B_A1857010.dat
Onset	568599	290.0	At Onset**	U1301B_O768599.dat
Onset	568600	314.0	At Onset**	U1301B_O768600.dat
Onset	568601	338.0	At Onset**	U1301B_O768601.dat
Antares	1857011*	361.0	At Antares**	U1301B_A1857011.dat
Antares	1857012*	383.0	No data. This section of sensor string was trapped by collapsed formation in open hole and broke off during IODP Exp 327recovery attempt in 2010.	
Antares	1857014*	402.0		
Antares	1857016*	421.0		
Antares	1857017*	440.0		
Antares	1857018*	459.0		
Antares	1857020*	483.5		
Antares	1857009*	510.0		
Antares	1857019*	521.5		
Antares	1857007*	528.0		

Loggers deployed 2010, IODP Exp 327, not yet recovered				
Antares	1857029	2.8		
Antares	1857032	13.0		
Antares	1857033	23.2		
Hole U1362A, basement depth = 236 mbsf				
Loggers deployed 2010, IODP Exp 327, recovered 2014, AT26-18				
Onset	768608	2.2	At Onset**	U1362A_O768608.dat
Onset	768609	13.4	At Onset**	U1362A_O768609.dat
Antares	1857021	220.9	At Antares**	U1362A_A1857021.dat
Antares	1857022	231.2	At Antares**	U1362A_A1857022.dat
Antares	1857023	288.6	No data	
Antares	1857024	298.8	At Antares**	U1362A_A1857024.dat
Antares	1857027	337.9	No data	
Antares	1857028	373.8	At UCSC**	U1362A_A1857028.dat
Antares	1857013	409.7	No data	
Antares	1857025	438.6	At UCSC**	U1362A_A1857025.dat
Antares	1857026	454.1	At UCSC**	U1362A_A1857026.dat
Hole U1362B, basement depth = 242 mbsf				
Loggers deployed 2010, IODP Exp 327, recovered 2014, AT26-18				
Antares	1857034	2.9	At UCSC**	U1362B_A1857034.dat
Antares	1857038	8.0	At Antares**	U1362B_A1857038.dat
Antares	1857039	14.2	At UCSC**	U1362B_A1857039.dat
Antares	1857040	24.4	At UCSC**	U1362B_A1857040.dat
Onset	768607	245.0	At Onset	U1362B_O768607.dat
Onset	768610	273.0	At Onset	U1362B_O768610.dat
Antares	1857035	276.9	At Antares**	U1362B_A1857035.dat
Antares	1857037	301.4	At UCSC**	U1362B_A1857037.dat

* The Antares loggers deployed in 2004 in Holes 1301A and1301B had been modified to maximize resolution in the expected temperature range of 50-90°C. This involved shifting the zero point such that valid data were recorded only for temperatures above a nominal value of ~40°C. When actual temperatures were below that, they were recorded as ~40°C values slightly different for each logger.

** Many of the deployments exceeded the nominal logger battery lifetimes of 3-4 years, so the loggers stopped recording at some point before they were recovered. To recover data from the non-volatile memory, those loggers had to be returned to the manufacturers or an electronics technician at UCSC. Some of the Onset data files were returned with battery voltage columns; others were not. For the Antares loggers returned to Antares or UCSC for data recovery, (1) the 'Logger Time' header line contains an invalid 1969 or 1970 date, and (2) the 'EndBatteryVoltage' header line actually records the external power applied to activate the loggers.