A Database for Seafloor Hydrothermal Spring Chemistry:
Report on Mini-Workshop at R2K Progress and Planning Workshop
Vancouver BC, Oct. 30-Nov. 2, 2005

M.J. Mottl (U. Hawaii) and K. Lehnert (LDEO), convenors

A one-hour workshop was held over lunch on Tuesday, Nov. 1, to discuss the design and construction of a database for seafloor hydrothermal spring chemistry. Seventeen persons attended (see list at end of this report). The group readily agreed that databases are essential for integrating and advancing knowledge in our field. The convenors noted that NSF-R2K ***requires*** that databases be constructed and maintained and that investigators deliver their data for inclusion in them. As a readily available electronic database for seafloor hydrothermal springs is presently not available to the community, the need for one was apparent. The group considered the following questions:

1) Is a simple data catalog adequate, or is it worth the investment to construct an integrated database?

A consensus was quickly reached that a fully integrated database was worth the extra cost, considering that its major scientific utility would be in integrating hot spring chemistry with a variety of other datasets to gain new insights. This task would be difficult and cumbersome with a data catalog but is the main object of an integrated database. The database is expected to have a long lifetime, moreover, and will inevitably grow through time. To fulfill its scientific objectives the database should be constructed for optimal flexibility and usefulness over a time scale of decades.

2) What should such a database look like?

2a) What ***settings*** should be included? Should we restrict ourselves to a) submarine b) hydrothermal c) springs?

A consensus was reached that we should be inclusive rather than exclusive. Besides the obvious inclusion of hot and warm springs along mid-ocean ridge and back-arc spreading axes, the group recommended that we include as well springs on arc and hot-spot volcanoes (e.g., Loihi Seamount), off-axis and ridge-flank springs (Lost City, Baby Bare), and springs in forearcs, such as those on the Mariana serpentinite mud volcanoes. There was also considerable support for including data on gas-hydrate seeps and submarine springs on continental margins, although neither of these is likely to be hydrothermally driven; an obvious advantage of including these categories is that the database would be useful to the MARGINS program as well as to R2K. In the end the group decided that the line should be drawn at subaerial springs, as there are many thousands of these that have been analyzed from myriad environments. Even in this case, however, it was felt that some subaerial springs should be included, such as those on arc volcanoes and in Iceland (e.g., the seawater-fed hot springs on the Reykjanes peninsula.

2b) What ***sample types*** should be included? Should we restrict ourselves to springs?

In keeping with an inclusive approach, the group decided that we should include conventional discrete water samples, continuous (time-series) in-situ chemical data both from vents and with lateral distance from vents, and sediment pore water profiles where upward seepage is evident and allows determination of the composition of an upwelling end-member water, as has been done, e.g., in the vicinity of the Baby Bare ridge-flank springs and those on serpentinite mud volcanoes in the Mariana forearc. The structure of the database should be flexible enough to handle these diverse data types.

More controversial was inclusion of data on hydrothermal plumes, including both buoyant and neutrally buoyant plumes. It was decided that the scientific objectives of a hydrothermal spring database require that plume data be included, as plumes are an essential component in determining the fate of the hydrothermal input to the oceans, and hence for estimating global hydrothermal chemical fluxes. Inclusion of plume data would allow immediate comparison between spring composition and plume composition, so that mixing rates with bottom seawater and chemical reactions in the plume could be more readily inferred. In any case, chemical ratios in plumes are useful for comparison with spring compositions, and in many cases are the only data available for a site of active venting that has not yet been visited by submersible. As some of the most useful plume data are physical (temperature, light scattering, etc.) rather than chemical, these physical data should be included as well. Plume data represent yet another diverse data type, but are probably no more different from the core type of spring water compositions than are compositional time-series data, for example.

Not discussed, for lack of time, was the inclusion of data on hydrothermal precipitates at seafloor springs, including deposits such as chimneys and suspended particles from plumes. It seems that the scientific rationale for including data on hydrothermal plumes applies equally well to precipitates, so the bias of the convenors is to include them in the database as well.

The remaining agenda is listed below, although our time was up before the group could discuss it.

2c) **Raw versus derived data**

Analyses of actual spring samples collected in one place at one time are typically used to determine the composition of a high-temperature end member that has mixed with bottom seawater, usually by extrapolating data from multiple samples to a zero concentration of Mg. The database should report these zero-Mg end-member compositions, as they are the single most scientifically useful product, as well as the underlying “raw” data on which they are based. The database should be constructed in a hierarchical fashion, with links to lateral databases and to higher level databases that contain global summary data, such as the Geochemical Earth Reference Model (GERM).

2d) What measures of ***data quality*** should be incorporated?

Essential components include the analytical method used for each chemical species and its typical uncertainty, including precision and accuracy. The latter measure should include the nature of the standards against which the analysis was done.

For analyses of seafloor hot springs, the report of the zero-Mg end member should include the lowest concentration of Mg actually measured (as a measure of the degree of contamination by seawater during sampling), the number of samples used to define mixing line, and its goodness of fit.

2e) What ***supporting information*** should be incorporated?

- x,y,z,t (lat., long., depth, date)
- Geologic setting *(MOR, arc, backarc, flank, etc.)*
- Description
- Substrate
- Sampling method and apparatus
- Temperature
- *Associated deposits and particles precipitated
- *Biota: macro- and microfauna
- Location where samples are archived
- References

* incorporated from other databases such as R2K DMS/mgDMS

2f) What ***chemical data*** should be incorporated?

- Major, minor, trace elements and species
- Dissolved gases
- Isotopes
- Units: moles per kg of solution

List of attendees

R. Batiza
J. Breier
D. Butterfield
D. Chayes
P. Craddock
H. Edmonds
C. German
D. Graham
C. Langmuir
K. Lehnert
T. McCollum
M.J. Mottl
B. Ransome
J. Seewald
W. Seyfried
J. Sharkey + one other