Qualitative Data Quality Evaluation Parameters

Grade *1 = Lowest reliability, *2 = Intermediate reliability, *3 = Highest reliability

Method	Grade	Requirements
Bedrock Borehole	R1	Derived from bedrock borehole temperature profile. No specific requirements or information on depth, location, or other variables.
	R2	Proven stable temperature profile. Maximum borehole depth greater than 90 m.
	R3	Proven stable temperature profile. Maximum borehole depth greater than 1,000 m. Low possibility of local temperature perturbations (e.g. hydrothermal circulation; active or residual basal shear heating from the ice sheet; temperature profile not steady state).
Ice Borehole	I1	Derived from ice borehole temperature profile. No specific requirements or information on depth, location, or other variables.
	I2	Ice sheet frozen to the bed. Proven stable temperature profile. Maximum borehole depth greater than 600 m.
	I3	Ice sheet frozen to the bed. Proven stable temperature profile. Maximum borehole depth greater than 1,000 m. Low possibility of local temperature perturbations (e.g. hydrothermal circulation; active or residual basal shear heating from the ice sheet; temperature profile not steady state).
Unconsolidated Sediment Probe	S1	Derived from unconsolidated sediment temperature profile. No specific requirements or information on depth, location, or other variables.
	S2	Proven stable temperature profile. Maximum probe depth greater than 3 m. Marine measurements from water depths greater than 500 m.
	S3	Proven stable temperature profile. Maximum probe depth greater than 5 m. Marine measurements from water depths greater than 1,000 m. Low possibility of local temperature perturbations (e.g. hydrothermal circulation; active or residual basal shear heating from the ice sheet; temperature profile not steady state).

Justification of depth requirements

R2 90 m bedrock borehole depth requirement
Temperatures from the Dry Valley Drilling Project provided estimates of "equilibrium" gradient only when deeper than 90 m (Decker, 1974; Decker et al., 1975; Pruss et al., 1974).

R3 1,000 m bedrock borehole depth requirement
Based on the skin depth calculations (Fig. 4 in the manuscript. Carslaw and Jaeger, 1959; Wangen, 2010), temperature variations of a one cycle periodicity less than 100,000 years do not penetrate below ~1,000 m in ice or rock.

I2 300 m ice borehole depth requirement
Based on the skin depth calculations (Fig. 4 in the manuscript), temperature variations of a one cycle periodicity less than 10,000 years do not penetrate below ~300 m in ice or rock.

I3 1,000 m ice borehole depth requirement
Based on the skin depth calculations (Fig. 4 in the manuscript), temperature variations of a one cycle periodicity less than 100,000 years do not penetrate below ~1,000 m in ice or rock.

S2 3 m probe depth requirement
3 m is the penetration depth of ~12 kyr thermal variability at 400 m water depth calculated by Dziadek et al. (2019). This skin depth increases at shallower water depths, and thins at greater depths.

S2 500 m water depth requirement
Water column temperatures are more variable in depths shallower than ~500 m, although this depth is variable (Dziadek et al., 2019; Wåhlin et al., 2010).

S3 5 m probe depth requirement
5 m exceeds the maximum skin depth penetrated into the sediments by sea floor temperature variations calculated by Dziadek et al. (2019). Temperature variations are within the measurement error.

S3 1,000 m water depth requirement
Negligible sub-annual temperature variability at depths greater than 1,000 m (Dziadek et al., 2019).

References

Carslaw, H. S. and Jaeger, J. C.: Conduction of heat in solids, Oxf. Clarendon Press 1959 2nd Ed, 1959.
Decker, E. R.: Preliminary geothermal studies of the Dry Valley Drilling Project holes at McMurdo Station, Lake Vanda, Lake Vida, and New Harbor, Antarctica, Bull.-Dry Val. Drill. Proj. DVDP, 4, 22–23, 1974.
Decker, E. R., Baker, K. H. and Harris, H.: Geothermal studies in the Dry Valleys and on Ross Island, Antarct. J., 10(4), 176, 1975.
Dziadek, R., Gohl, K. and Kaul, N.: Elevated geothermal surface heat flow in the Amundsen Sea Embayment, West Antarctica, Earth Planet. Sci. Lett., 506, 530–539, 2019.
Pruss, E. F., Decker, E. R. and Smithson, S. B.: Preliminary temperature-measurements at DVDP holes 3, 4, 6, and 8, Antarct. J. U. S., 9(4), 133–134, 1974.
Wåhlin, A. K., Yuan, X., Björk, G. and Nohr, C.: Inflow of warm Circumpolar Deep Water in the central Amundsen shelf, J. Phys. Oceanogr., 40(6), 1427–1434, 2010.
Wangen, M.: Physical principles of sedimentary basin analysis, Cambridge University Press, Cambridge, UK., 2010.