Structurally controlled fluid-rock interaction during development of the giant Mount Isa copper deposit

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SUPPORTING INFORMATION

Supplementary Figures

Figure S-1. a, Simplified geology map of the Isa valley. **b,** Map of carbonate $\delta^{18}O_{wr}$ alteration model and copper orebodies projected to surface. Co-ordinates are provided in Mount Isa Grid.

Figure S-2. Reproduction of Figure 4 without fluid flow interpretations.

Figure S-3. Reproduction of Figure 5 without overlaid structures or copper oreshells.

Video S -1. 3D model of Mount Isa, linking all 2D figures within 3D space.

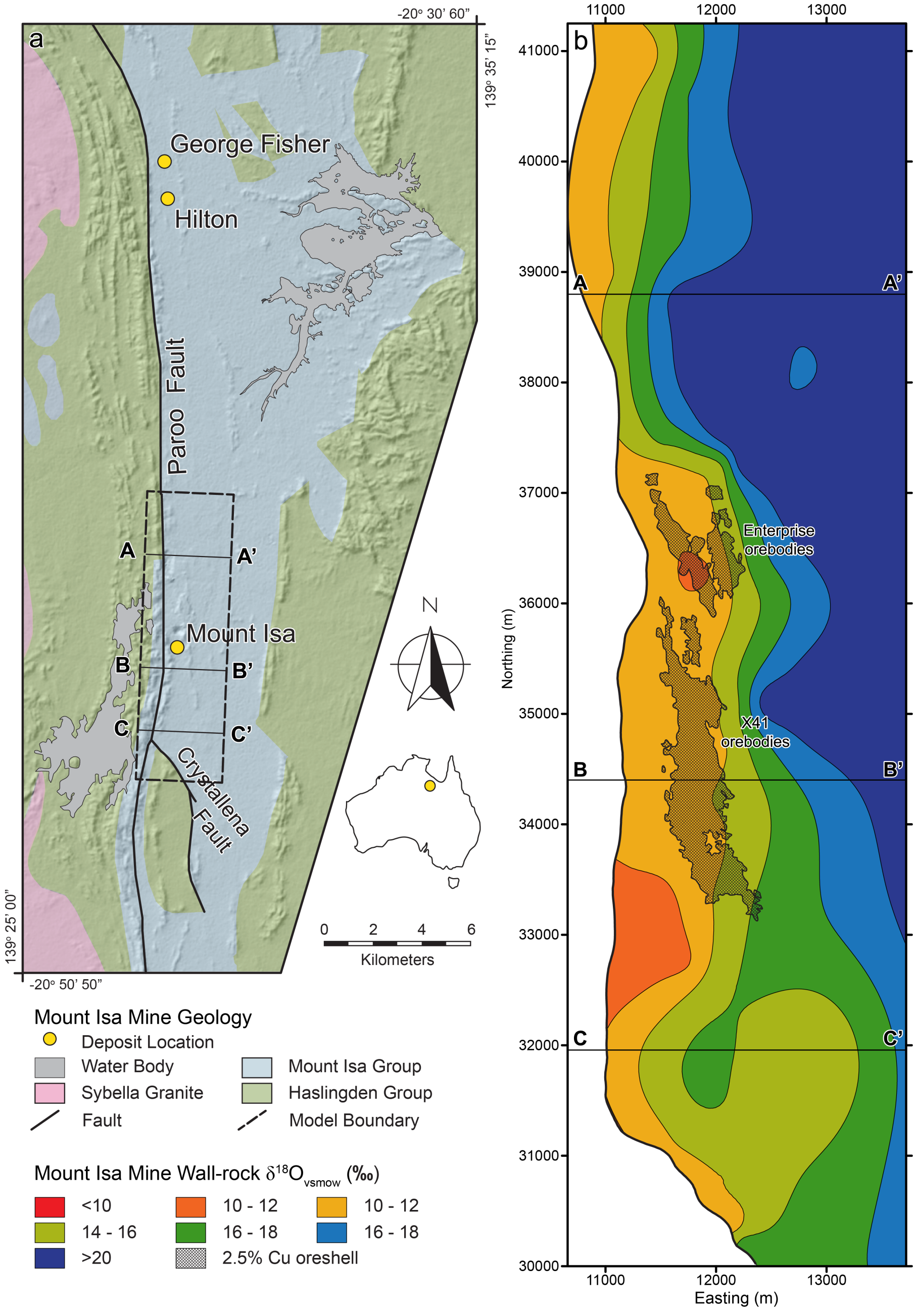
Supplementary Tables

Table S-1. Carbonate clumped isotope thermometry sample description, sample location co-ordinates are provided in local Mount Isa Grid and elevations a referenced to the Australian Height Datum (AHD). Sample list is sorted from south-north, left to right in Figure 2.

Table S-2. Summary table of carbonate clumped isotope thermometry results.

Table S-3. Carbonate clumped isotope thermometry analytical results.

Table S-4. OA-ICOS carbonate $\delta^{18}O$ analytical results, sample location co-ordinates are provided in local Mount Isa Grid and elevations a referenced to the Australian Height Datum (AHD).



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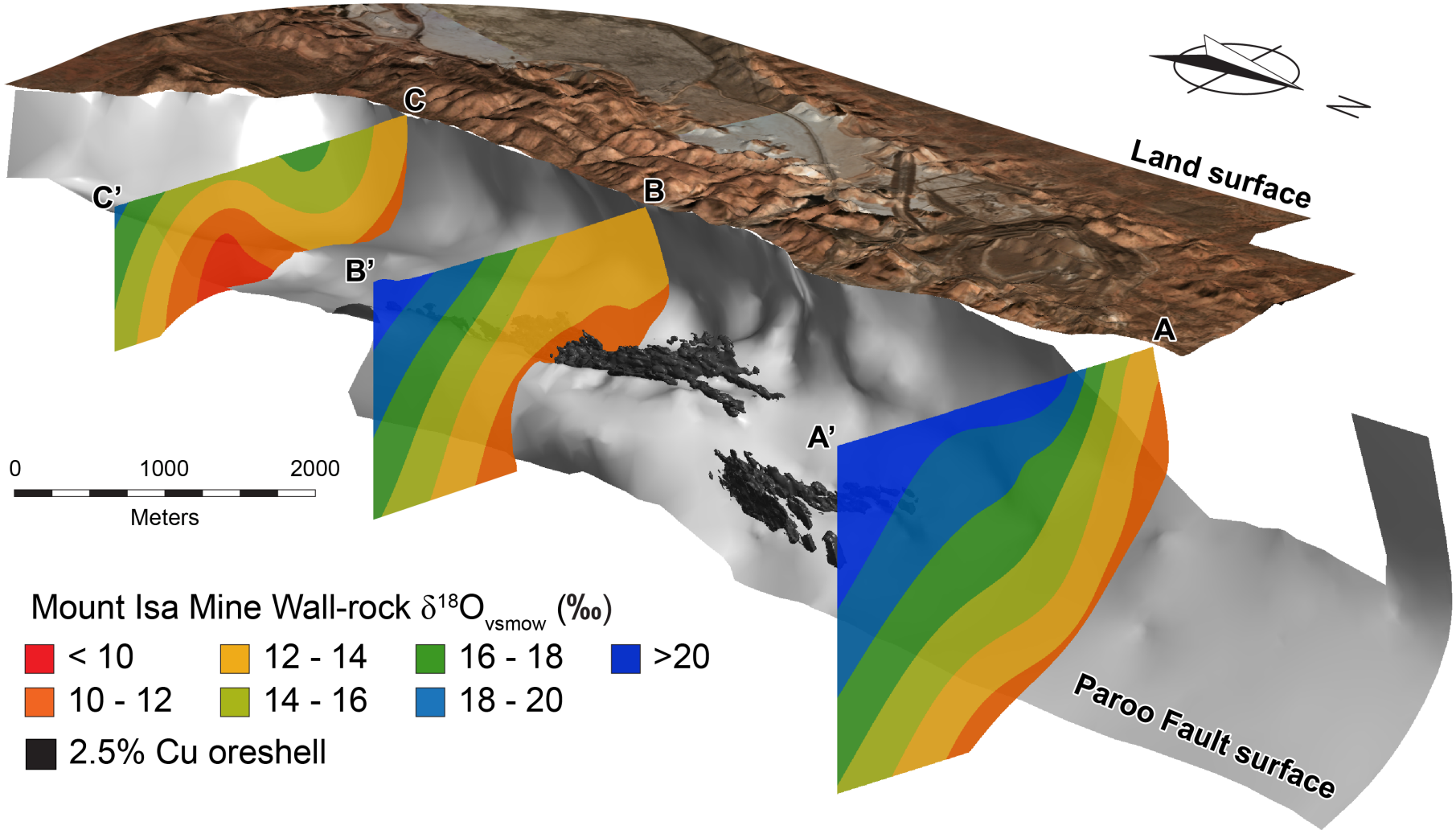

Figure S-2. Reproduction of Figure 4 without fluid flow interpretations.

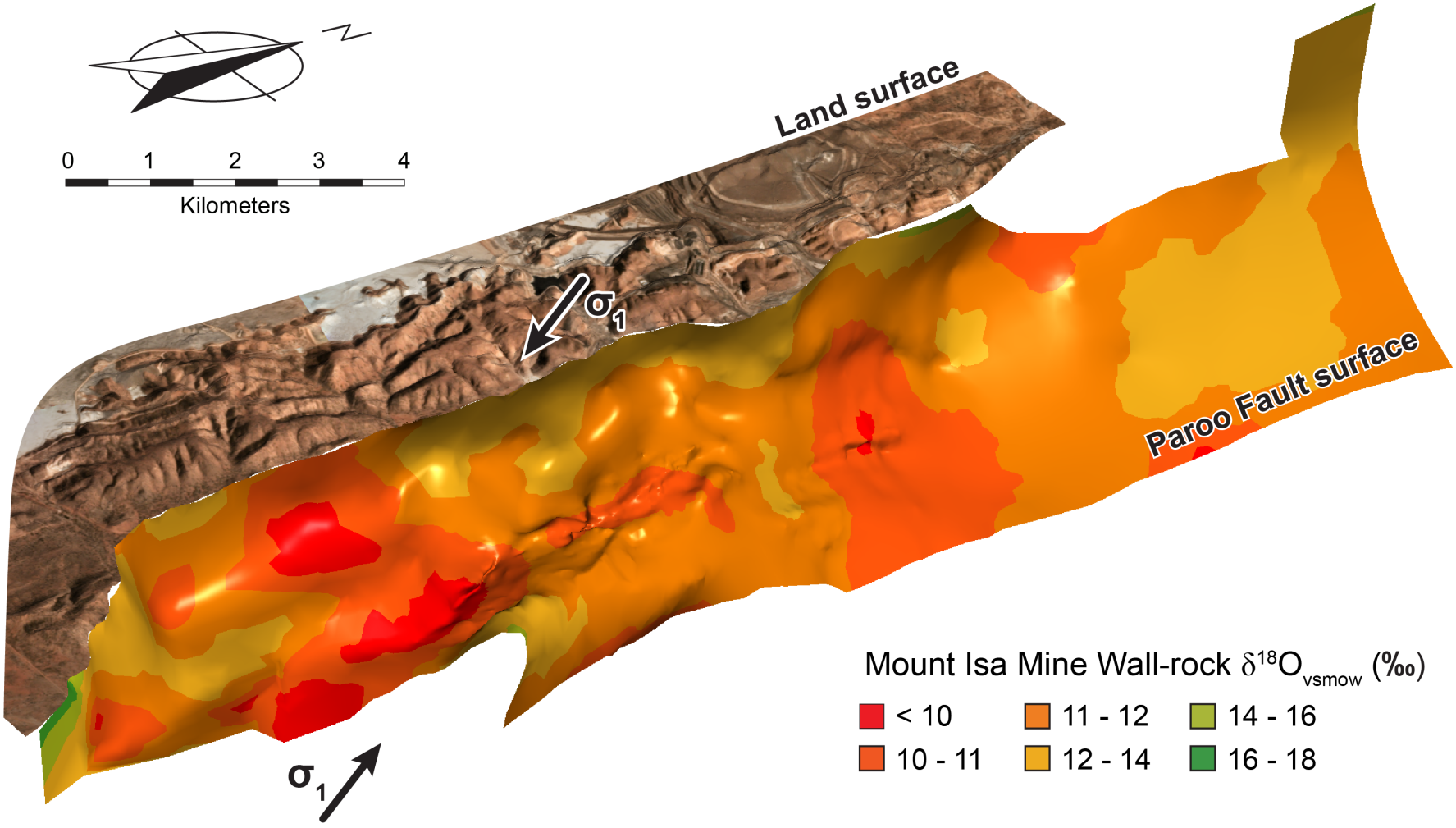

Figure S-3. Reproduction of Figure 5 without overlaid structural interpretations or copper ore-shell

Table S-1. Carbonate clumped isotope thermometry sample description

Sample	Drill Hole ID	Easting (m)*	Northing (m)*	Elevation (m)†	Sample Description
EX105638	GEMED1	11863	31388.7	-226.0	Dolomite vein in dark grey silicified shale
EX105621	SXFED1	12334.3	32797.3	-377.2	Dolomite vein in dark grey moderately silicified laminated shale
EX096653	SOXED3	12052.6	32814.1	-420.0	Dolomite stockwork veining with cross cutting fine grained pyrite in silicified dark grey shale
EX096743	O385ED1	12165.9	33825.9	-414.8	Very coarse grain white dolomite vein with coarse cubic pyrite in highly silicified dark grey shale
EX096738	O385ED1	12024.8	33834.0	-202.4	Irregular silica dolomite vein with cubic pyrite in dark grey shale
EX096728	O385ED1	11799.1	33842.8	184.8	Dolomite crackle breccia with trace sulphide in grey siltstone
11L 5417 XC2		11607.7	35410.8	-122.9	Coarse grained dolomite vein with irregular chalcopyrite in dark grey silicified shale
29E J71 8871		11512	37172.1	-1116	Coarse grained dolomite tension vein very fine grained bedded pyrite
EX105586A	B813WD1	10994.5	38144.7	-685.9	Large coarse grain dolomite vein with cross-cutting calcite vein in dark grey moderately silicified shale

*Local Mount Isa Grid co-ordinates

†Australian Height Datum

Table S-2. Summary table of carbonate clumped isotope thermometry results.

Sample	# of analyses	$\delta^{13}C_{mineral}$ (vpdb) (‰)	$\delta^{13}C$ error (‰)	$\delta^{18}O_{mineral}$ (vsmow) (‰)	$\delta^{18}O$ error (‰)	Δ_{47} (ARF) (‰)	Δ_{47} std. error (‰)	$T\,\Delta_{47}$ (°C)‡ (± 1SE)	$\delta^{18}O_{fluid}$ (vsmow)† (‰)	$T\,\Delta_{47}$ (°C)§ (± 1SE)
EX105638	3	-3.870	0.015	12.748	0.088	0.295	0.020	218^{+31}_{-26}	2.8±1.5	290^{+51}_{-40}
EX105621*	1	-5.339	0.007	11.700	0.004	0.257	0.022	280^{+50}_{-39}	4.5±1.6	397^{+102}_{-70}
EX096653	3	-5.611	0.028	11.106	0.029	0.240	0.033	318^{+101}_{-67}	5.2±2.5	471^{+264}_{-127}
EX096743	3	-4.974	0.027	11.083	0.035	0.229	0.016	347^{+49}_{-40}	6.0±1.2	536^{+129}_{-84}
EX096738	3	-5.590	0.005	11.746	0.039	0.250	0.011	296^{+25}_{-22}	5.1±0.8	427^{+52}_{-42}
EX096728	3	-4.753	0.004	12.813	0.029	0.243	0.030	311^{+86}_{-60}	6.7±2.2	458^{+211}_{-113}
11L 5417 XC2	3	-5.708	0.014	11.398	0.050	0.258	0.029	279^{+68}_{-49}	4.2±2.1	395^{+141}_{-86}
29E J71 8871	3	-5.814	0.002	10.703	0.038	0.246	0.017	304^{+42}_{-34}	4.4±1.2	443^{+91}_{-66}
EX105586A*	1	-5.491	0.007	12.800	0.004	0.291	0.022	223^{+35}_{-29}	3.2±1.6	297^{+59}_{-45}

*For samples where only one analysis was completed, instrument error is reported for $\delta^{13}C$ and $\delta^{18}O$, for Δ_{47} we report the average standard error of all Mount Isa samples to account for possible sample heterogeneity.

‡ Temperature calculated using the calibration of Bonifacie et al.[9] $\Delta_{47}=0.0482\times 10^6/T^2-0.1174$

†$\delta^{18}O_{fluid}$ calculated using the isotopic fractionation factor of Horita[11] $10^3\ln\alpha_{dol\text{-}H_2O}=3.14\times 10^6/T$ -3.14

§Temperature calculated using the calibration of Kluge et al.[10] $\Delta_{47}=0.0405\times 10^6/T^2-0.167$