

Carbon and oxygen isotope in situ analysis of calcite using secondary ion mass spectrometry in the Permian Kupferschiefer system, Saale subbasin, Eastern Germany (<https://doi.org/10.5880/GFZ.3.1.2023.003>)

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2. Citation

When using the data please cite:

Mohammedyasin, M. S.; Magnall, J. M.; Gleeson, S. A.; Schulz, H.-M.; Scicchitano, M. R. (2023): Carbon and oxygen isotope in situ analysis of calcite using secondary ion mass spectrometry in the Permian Kupferschiefer system, Saale subbasin, Eastern Germany. V. 1. GFZ Data Services. <https://doi.org/10.5880/GFZ.3.1.2023.003>

The data are supplementary material to:

Mohammedyasin, M. S.; Magnall, J. M.; Gleeson, S. A.; Schulz, H.-M.; Scicchitano, M. R. (2023): Carbon and oxygen isotope microanalysis of calcite in the Permian Kupferschiefer system, Saale subbasin, eastern Germany. *Chemical Geology*. 10.1016/j.chemgeo.2023.121811

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4. Data description

The Kupferschiefer districts in Central Europe contain some of the world's highest-grade sediment-hosted stratiform Cu (SSC) deposits (see Borg et al., 2012). The high-grade sulfide mineralization in the organic matter-rich marine mudstones of the Kupferschiefer (T1), and also in the underlying continental sandstones of the uppermost Rotliegend (S1) and overlying Zechstein Limestone (Ca1), in the Saale subbasin (Eastern Germany) are dominantly formed as a replacement of calcite cement (Mohammedyasin et al., 2023).

We provide carbonate major element chemistry, carbon isotope composition of organic matter ($\delta^{13}\text{C}_{\text{org}}$), and calcite carbon and oxygen isotope microanalysis datasets of drill core samples from the Saale subbasin in Eastern Germany. The samples include the uppermost Rotliegend sandstone (S1), Kupferschiefer (T1) mudstones and lowermost Zechstein Limestone (Ca1), referred as the Kupferschiefer system, from three drill cores (Sangerhausen, Allstedt and Wallendorf).

This data publication includes carbonate major element chemistry (electron probe microanalysis, EPMA), $\delta^{13}\text{C}_{\text{org}}$ values (isotope ratio mass spectrometry, IRMS), and $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values of calcite (cement and veins) that were analyzed using secondary ion mass spectrometry (SIMS), all at GFZ Potsdam.

3.1. Sampling methods

Drill core samples were collected from three different locations (Sangerhausen, Wallendorf and Allstedt) in the Saale subbasin in Eastern Germany. The three drill cores comprise the Rote Fäule and Cu zone (Sangerhausen, SHN) and the overlapping Zn-Pb zone (Wallendorf, WDF and Allstedt, AST). A total of 47 samples (SHN =17, AST = 17 and WDF = 13) were collected from all drill cores following a near continuous sampling approach (every ~5 cm). Powdered samples were prepared for total organic matter analysis. Thin sections were prepared and carbon coated for major element analyses of carbonate phases (calcite and dolomite). On prepared thick sections, regions of interest (calcite cement and veins) were extracted using a micro drill press and a total of 30 grains were prepared into two mounts together with calcite reference materials (UWC-3, IAEA-603).

3.2. Analytical procedures

The major element chemistry of dolomite and calcite were analysed using electron probe microanalyzer (EPMA) equipped with wavelength-dispersive spectrometry (WDS).

The carbon isotope composition of organic matter ($\delta^{13}\text{C}_{\text{org}}$) were measured on powdered samples (3 mg each) after decalcifying in an Ag-capsule with 3% HCl and then 20% HCl, and heated at 75 °C for 3 hrs. The organic matter carbon isotope analyses were done using isotope ratio mass spectrometry (IRMS).

Two mounts (each with 15 grains) were prepared with flat surfaces, then gold coated. Detail backscattered electron (BSE) imaging were done before the SIMS analysis for calcite target selection. Calcite (cement veins) in the samples and reference materials were analysed using secondary ion mass spectrometry (SIMS). The mass resolution of the SIMS was set at $M/\Delta M \approx 2000$ (oxygen isotopes) and 3200 (carbon isotopes), at 10% of peak height. The reported errors are better than $\pm 0.20\%$ (1SE) for $\delta^{18}\text{O}$ values and $\pm 0.40\%$ (1SE) for $\delta^{13}\text{C}$ values.

3.3. Data processing

The major elements analyzed in oxide forms were converted in to carbonate form, which has been used in reporting and interpretation of this data.

For the isotopic values, further data reduction has been done and the data have been reported in Vienna Pee-Dee Belemnite (VPDB) for the carbon $\delta^{13}\text{C}$ values and both in VPDB and Vienna Standard Mean Ocean Water (VSMOW) for the oxygen $\delta^{18}\text{O}$ values.

5. File description

The six files stored in the zipped folder “2023-001 Mohammedyasin et al._Data publication” are listed in the Table 1.

Table 1. Name, type and description of files included in this data publication.

S.N	Name	Type	Description
1	2023-003_Mohammedyasin-et-al_Data-description	.pdf	Data description
2	2023-003_Mohammedyasin-et-al_Supplementary-Table-1_EPMA-carbonate-chemistry-	.xlsx	Carbonate chemistry data with details (Data source, samples, data, Primary analytical metadata, Method specific metadata)
3	2023-003_Mohammedyasin-et-al_Supplementary-Table-2_IRMS- $\delta^{13}\text{C}_{\text{org}}$.xlsx	The $\delta^{13}\text{C}_{\text{org}}$ values with detail information (Data source, samples, data, Primary analytical metadata, Method specific metadata)
4	2023-003_Mohammedyasin-et-al_Supplementary-Table-3_SIMS- $\delta^{13}\text{C}$.xlsx	Detail $\delta^{13}\text{C}$ data reduction (Compile_ $\delta^{13}\text{C}$, Calibrate_ $\delta^{13}\text{C}$, $\delta^{13}\text{C}$ calcite) with metadata
5	2023-003_Mohammedyasin-et-al_Supplementary-Table-4_SIMS- $\delta^{18}\text{O}$.xlsx	Detail $\delta^{18}\text{O}$ data reduction (Compile_ $\delta^{18}\text{O}$, Calibrate_ $\delta^{18}\text{O}$, $\delta^{18}\text{O}$ calcite) and metadata
6	2023-003_Mohammedyasin-et-al_Supplementary-Table-5_SIMS- $\delta^{13}\text{C}$ -and- $\delta^{18}\text{O}$ -data-used-for-plotting-	.xlsx	$\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values used for plotting

6. References

Borg, G., Piestrzynski, A., Bachmann, G.H., Püttmann, W., Walther, S., Fiedler, M., 2012: An Overview of the European Kupferschiefer Deposits*, in: Hedenquist, J.W., Harris, M., Camus, F. (Eds.), *Geology and Genesis of Major Copper Deposits and Districts of the World: A Tribute to Richard H. Sillitoe*. Society of Economic Geologists 16, pp. 455–486. <https://doi.org/10.5382/SP.16.18>

Mohammedyasin, M.S., Magnall, J.M., Gleeson, S.A., Schulz, Hans-Martin Schleicher, A.M., Stammeier, J.A., Ehling, B.-C., (2023): Diagenetic History and Timing of Cu and Zn-Pb Sulfide Mineralization in the Permian Kupferschiefer System, Saale Subbasin, Eastern Germany. *Economic Geology*. 10.5382/econgeo.5015