# APPENDICES

## A1

Table A.1: Depth and thickness of the Trigonodus Dolomit and the Dolomit der Anhydritgruppe at all the wells investigated in this study.

| Well | Depth TD (m) | Thickness TD (m) | Depth DAG (m) | Thickness DAG (m) | Basis for estimating lithological boundaries |
|---|---|---|---|---|---|
| Bözberg (BOZ) | 58.4–96.0 | 37.6 | 136.0–148.8 | 12.8 | DC |
| Böttstein (BOE) | 121.9–150.8 | 28.9 | 197.2–204.6 | 7.4 | Nagra, 1985 |
| Siblingen (SIB) | 177.0–207.8[3] | 30.8 | 233.7–249.4 | 15.7 | Nagra, 1992b |
| Riniken (RIN) | 616.0–652.4 | 36.4 | 688.5–698.5 | 10.0 | Nagra, 1990 |
| Benken (BEN) | 811.4–848.5 | 37.1 | 874.3–886.3 | 12.0 | Nagra, 2001 |
| Weiach (WEI) | 819.1–857.1 | 38.0 | 887.9–897.7 | 9.8 | Nagra, 1989 |
| Schlattingen (SLA) | 1112.0–1145.3 | 33.3 | 1169.5–1179.1 | 9.6 | Diamond et al., 2013 |
| Schafisheim (SHA) | 1228.3–1256.3 | 28.0 | 1287.7–1305.0 | 17.3 | Nagra, 1992a |
| Pfaffnau (PFA) | ~ 1546–1575 | ~ 29.0 | ~ 1610–1622[1] | ~ 12.0 | Büchi et al., 1965 |
| Herdern (HER) | 1990–2020 | 30.0 | ~ 2052–2062 | ~ 10.0 | This study. |
| Berlingen (BER) | ~ 2179–2191 | ~ 12.0 | ~ 2245–2257[1] | ~ 12.0 | Büchi et al., 1965 |
| Kreuzlingen (KRE) | ~ 2415–2433[2] | ~ 18.0 | ~ 2480–2492[1] | ~ 12.0 | Büchi et al., 1965 |
| Lindau (LIN) | ~ 2225–2267[2] | ~ 42.0 | ~ 2285–2297[1] | ~ 12.0 | Büchi et al., 1965 |

TD: Trigonodus Dolomit; DAG: Dolomit der Anhydritgruppe

DC: drill core

[1] Exact depth of base of DAG cannot be determined precisely. Tabulated values are rough estimates.

[2] Exact depth of base of TD cannot be determined precisely. Tabulated values are minima based on our drill core investigations.

### References:


Büchi U.P., Lemcke K., Wiener G., Zimdars J. (1965) Geologische Ergebnisse der Erdölexploration auf das Mesozoikum im Untergrund des schweizerischen Molassebeckens. Bulletin der Vereinigung Schweizerischer Petroleum-Geologen und -Ingenieure 32, 7–38.

Nagra (1985) Sondierbohrung Böttstein Untersuchungsbericht - Nagra Technischer Bericht NTB 85-01. Nagra, Wettingen, Switzerland.

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Nagra (1990) Sondierbohrung Riniken Untersuchungsbericht - Nagra Technischer Bericht NTB 88-09. Nagra, Wettingen, Switzerland.

Nagra (1992a) Sondierbohrung Schafisheim Untersuchungsbericht - Nagra Technischer Bericht NTB 88-11. Nagra, Wettingen, Switzerland.

Nagra, 1992b. Sondierbohrung Siblingen Untersuchungsbericht - Nagra Technischer Bericht NTB 90-34. Nagra, Wettingen, Switzerland.

# A2

Table A.2: Strontium isotope data for minerals and groundwater from various wells across the Swiss Molasse Basin.

| Locality | Sample depth (m) | Phase | Occurrence | Unit | $^{87}Sr/^{86}Sr$ | Sr (µg/g) |
|---|---|---|---|---|---|---|
| Benken | 828.14 | Dolomite | Rock matrix | TD | 0.70844 [1] | 89 [1] |
| Benken | 836.46 | Dolomite | Rock matrix | TD | 0.70863 [1] | 32 [1] |
| Schlattingen | 1116.66 | Dolomite | Rock matrix | TD | 0.70886 | 45 |
| Schlattingen | 1121.87 | Dolomite | Rock matrix | TD | 0.70869 | 44 |
| Schlattingen | 1126.48 | Dolomite | Rock matrix | TD | 0.70979 | 35 |
| Schlattingen | 1127.83 | Dolomite | Rock matrix | TD | 0.71016 | 36 |
| Schafisheim | 1252.38 | Dolomite | Rock matrix | TD | 0.70967 | – |
| Schafisheim | 1233.93 | Dolomite | Rock matrix | TD | 0.70812 [2] | 85 [2] |
| Böttstein | 137.2 | Dolomite | Rock matrix | TD | 0.71053 [2] | 586 [2] |
| Bözberg | 64.82 | Dolomite | Rock matrix | TD | 0.70804 | – |
| Bözberg | 94.66 | Dolomite | Rock matrix | TD | 0.70876 | – |
| Benken | 853.98 | Dolomite + Calcite | Rock matrix | HMK | 0.70868 [1] | 89 [1] |
| Schlattingen | 1167.88 | Dolomite + Calcite | Rock matrix | HMK | 0.70824 | 198 |
| Schlattingen | 1168.31 | Dolomite + Calcite | Rock matrix | HMK | 0.70832 | 185 |
| Bözberg | 98.52 | Dolomite + Calcite | Rock matrix | HMK | 0.70919 | – |
| Schafisheim | 1334.99 | Dolomite + Calcite | Rock matrix | HMK | 0.70813 | – |
| Weiach | 828.57-1 | Anhydrite | Nodules and beds | TD | 0.70880 | 1026 |
| Weiach | 828.57-2 | Anhydrite | Nodules and beds | TD | 0.70872 | 977 |
| Weiach | 831.33-1 | Anhydrite | Nodules and beds | TD | 0.70876 | 1090 |
| Weiach | 831.33-2 | Anhydrite | Nodules and beds | TD | 0.70885 | 1144 |
| Weiach | 834.25 | Anhydrite | Nodules and beds | TD | 0.70860 | 1134 |
| Weiach | 824.85 | Anhydrite | Nodules and beds | TD | 0.70953 [2] | 2437 [2] |
| Weiach | 828.72 | Anhydrite | Nodules and beds | TD | 0.70874 [2] | 1222 [2] |
| Schlattingen | 1121.87 | Anhydrite | Nodules and beds | TD | 0.70846 | 1368 |
| Schlattingen | 1133.43 | Anhydrite | Nodules and beds | TD | 0.70900 | 1458 |
| Schafisheim | 1234.67 | Anhydrite | Nodules and beds | TD | 0.70822 | – |
| Schafisheim | 1294.17 | Anhydrite | Nodules and beds | DAG | 0.70805 | – |
| Schafisheim | 1295.76 | Anhydrite | Nodules and beds | DAG | 0.70804 | – |
| Weiach | 749.60 | Anhydrite | Nodules and beds | Keuper | 0.70821 [2] | 1893 [2] |
| Böttstein | 53.37 | Anhydrite | Nodules and beds | Keuper | 0.70811 [2] | 1576 [2] |
| Böttstein | 53.37 | Anhydrite | Nodules and beds | Keuper | 0.70814 [2] | 2150 [2] |
| Böttstein | 59.00 | Anhydrite | Nodules and beds | Keuper | 0.70810 [2] | 886 [2] |
| Böttstein | 88.90 | Anhydrite | Nodules and beds | Keuper | 0.70807 [2] | 2701 [2] |
| Benken | 730.76 | Anhydrite | Nodules and beds | Keuper | 0.70840 [1] | 1896 [1] |
| Weiach | 898.03 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70798 | 1585 |
| Weiach | 904.43 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70803 | 2746 |
| Weiach | 912.10 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70796 | 1052 |
| Weiach | 923.27 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70829 | 1570 |
| Weiach | 928.58 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70806 | 1335 |
| Weiach | 937.74 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70846 | 1420 |
| Weiach | 941.38 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70845 | 2139 |
| Weiach | 943.12 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70854 | 2056 |

Continuation of Table A.2

| Locality | Sample depth (m) | Phase | Occurrence | Unit | $^{87}Sr/^{86}Sr$ | Sr (µg/g) |
|---|---|---|---|---|---|---|
| Weiach | 910.15 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70783 [2] | 1105 [2] |
| Schafisheim | 1374.25 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70785 [2] | 1142 [2] |
| Leuggern | 116.43 | Anhydrite | Nodules and beds | Sulfatschichten | 0.70784 [2] | 1196 [2] |
| Böttstein | 122.65 | Calcite | Pore-filling | TD | 0.70936 [2] | 100 [2] |
| Böttstein | 150.99 | Calcite | Fracture-filling | TD | 0.70877 | – |
| Leuggern | 54.08 | Calcite | Pore-filling | TD | 0.70905 [2] | 58 [2] |
| Benken | 846.46-1 | Calcite | Shear surface | TD | 0.70865 [1] | 61 [1] |
| Benken | 846.46-2 | Calcite | Pore-filling | TD | 0.70839 [1] | 34 [1] |
| Schafisheim | 1252.77-1 | Calcite | Pore-filling | TD | 0.70882 | – |
| Schafisheim | 1252.77-2 | Calcite | Pore-filling | TD | 0.70858 | – |
| Weiach | 844.99 | Calcite | Pore-filling | TD | 0.71016 | – |
| Weiach | 861.58 | Calcite | Pore-filling | HMK | 0.70929 | – |
| Benken | 853.98 | Calcite | Fracture-filling | HMK | 0.71079 [1] | 105 [1] |
| Benken | 866.41 | Calcite | Pore-filling | HMK | 0.71123 | 133 |
| Benken | 866.42 | Calcite | Pore-filling | HMK | 0.71137 | 110 |
| Benken | 866.44 | Calcite | Pore-filling | HMK | 0.71090 | 67 |
| Benken | 866.46 | Calcite | Pore-filling | HMK | 0.71173 | 139 |
| Schlattingen | 1157.34 | Calcite | Pore-filling | HMK | 0.71629 | 204 |
| Schlattingen | 1164.33 | Calcite | Pore-filling | HMK | 0.70964 | 1924 |
| Schlattingen | 1167.88 | Calcite | Fracture-filling | HMK | 0.71289 | 197 |
| Schlattingen | 1168.31 | Calcite | Pore-filling | HMK | 0.71260 | 169 |
| Schafisheim | 1329.20 | Calcite | Fracture-filling | HMK | 0.70966 [2] | 233 [2] |
| Schafisheim | 1285.34 | Calcite | Tension gash | HMK | 0.70965 | – |
| Schafisheim | 1330.70 | Calcite | Fracture-filling | HMK | 0.70959 | – |
| Schafisheim | 1334.99 | Calcite | Fracture-filling | HMK | 0.70968 | – |
| Bözberg | 98.52 | Calcite | Fracture-filling | HMK | 0.70838 | – |
| Bözberg | 135.69 | Calcite | Fracture-filling | HMK | 0.71231 | – |
| Siblingen | 209.95 | Calcite | Pore-filling | HMK | 0.70945 | – |
| Benken | 878.25 | Calcite | Fracture-filling | DAG | 0.71023 [1] | 1098 [1] |
| Bözberg | 147.61 | Calcite | Fracture-filling | DAG | 0.70855 | – |
| Böttstein | 196.94 | Calcite | Pore-filling | DAG | 0.71213 | – |
| Siblingen | 241.60 | Calcite | Fracture-filling | DAG | 0.70938 | – |
| Benken | 401.68 | Calcite | Fracture-filling | Jurassic | 0.70712 [1] | 231 [1] |
| Benken | 519.96 | Calcite | Fracture-filling | Jurassic | 0.70763 [1] | – |
| Benken | 635.67 | Calcite | Fracture-filling | Jurassic | 0.70847 [1] | 283 [1] |
| Benken | 657.62 | Calcite | Pore-filling | Jurassic | 0.70758 [1] | 342 [1] |
| Benken | 712.76 | Calcite | Fracture-filling | Keuper | 0.70925 [1] | 189 [1] |
| Benken | 713.26 | Calcite | Fracture-filling | Keuper | 0.70921 [1] | 296 [1] |
| Schafisheim | 1485.75 | Calcite | Fracture-filling | Buntsandstein | 0.71300 [2] | 3566 [2] |
| Riniken | 805.00 | Calcite | Pore-filling | Buntsandstein | 0.71504 [2] | 290 [2] |
| Leuggern | 218.61 | Calcite | Pore-filling | Buntsandstein | 0.71659 [2] | 107 [2] |
| Riniken | 1045.45 | Calcite | Fracture-filling | Permian | 0.71618 [2] | 286 [2] |
| Kaisten | 1046.36 | Calcite | Fracture-filling | CB | 0.71701 [2] | 148 [2] |
| Leuggern | 1511.32 | Calcite | Fracture-filling | CB | 0.71156 [2] | – |

Continuation of Table A.2

| Locality | Sample depth (m) | Phase | Occurrence | Unit | $^{87}Sr/^{86}Sr$ | Sr (µg/g) |
|---|---|---|---|---|---|---|
| Leuggern | 1525.97 | Calcite | Fracture-filling | CB | 0.71105 [2] | – |
| Leuggern | 318.65 | Calcite | Fracture-filling | CB | 0.71129 | – |
| Siblingen | 1023.62 | Calcite | Fracture-filling | CB | 0.71535 | – |
| Benken | 998.99 | Calcite | Fracture-filling | CB | 0.71111 | – |
| Schlattingen | 1116.66-1 | Anhydrite | Fracture-filling | TD | 0.71035 | 1876 |
| Schlattingen | 1116.66-2 | Anhydrite | Fracture-filling | TD | 0.70987 | 1616 |
| Schlattingen | 1135.58 | Anhydrite | Pore-filling | TD | 0.71048 | 2082 |
| Schlattingen | 1136.98 | Anhydrite | Pore-filling | TD | 0.70880 | 1562 |
| Schlattingen | 1127.83 | Anhydrite | Fracture-filling | TD | 0.70897 | 966 |
| Schlattingen | 1135.29 | Anhydrite | Pore-filling | TD | 0.70928 | 182 |
| Schlattingen | 1140.15 | Anhydrite | Pore-filling | TD | 0.71004 | 742 |
| Schafisheim | 1228.45 | Anhydrite | Fracture-filling | TD | 0.70983 | – |
| Schafisheim | 1330.70 | Anhydrite | Fracture-filling | HMK | 0.70951 | – |
| Schafisheim | 1334.99 | Anhydrite | Fracture-filling | HMK | 0.70995 | – |
| Berlingen | 2189.45 | Saddle dolomite | Pore-filling | TD | 0.71273 | – |
| Berlingen | 2189.01 | Saddle dolomite | Pore-filling | TD | 0.71239 | – |
| Berlingen | 2180.64 | Saddle dolomite | Pore-filling | TD | 0.71330 | – |
| Berlingen | 2181.37 | Saddle dolomite | Pore-filling | TD | 0.71324 | – |
| Berlingen | 2189.11 | Saddle dolomite | Pore-filling | TD | 0.71227 | – |
| Berlingen | 2179.87 | Saddle dolomite | Pore-filling | TD | 0.71313 | – |
| Lindau | 2245.35 | Saddle dolomite | Pore-filling | TD | 0.71217 | – |
| Lindau | 2232.64 | Saddle dolomite | Pore-filling | TD | 0.71219 | – |
| Kreuzlingen | 2422.75 | Saddle dolomite | Pore-filling | TD | 0.71313 | – |
| Kreuzlingen | 2431.39 | Saddle dolomite | Pore-filling | TD | 0.71306 | – |
| Kreuzlingen | 2427.18 | Saddle dolomite | Pore-filling | TD | 0.71338 | – |
| Kreuzlingen | 2422.95 | Saddle dolomite | Pore-filling | TD | 0.71339 | – |
| Herdern | 1990.01 | Saddle dolomite | Pore-filling | TD | 0.71280 | – |
| Herdern | 1995.57 | Saddle dolomite | Pore-filling | TD | 0.71265 | – |
| Herdern | 1998.93 | Saddle dolomite | Pore-filling | TD | 0.71233 | – |
| Böttstein | 1490.70 | Rock matrix | Whole rock | CB | 0.72716 [2] | 207 [2] |
| Weiach | 2220.12 | Rock matrix | Whole rock | CB | 0.71441 [2] | 244 [2] |
| Kaisten | 1038.83 | Rock matrix | Whole rock | CB | 0.72392 [2] | – |
| Kaisten | 1046.36 | Rock matrix | Whole rock | CB | 0.72305 [2] | – |
| Leuggern | 1525.97 | Rock matrix | Whole rock | CB | 0.72859 [2] | 206 [2] |
| Leuggern | 1636.90 | Rock matrix | Whole rock | CB | 0.76098 [2] | 290 [2] |
| Schafisheim | 1879.79 | Rock matrix | Whole rock | CB | 0.71405 [2] | 494 [2] |
| Benken | 396.62 | Rock matrix | Whole rock | Malm | 0.70704 [1] | 385 [1] |
| Benken | 401.68 | Rock matrix | Whole rock | Malm | 0.70708 [1] | 390 [1] |
| Benken | 519.96 | Rock matrix | Whole rock | Dogger | 0.70743 [1] | 216 [1] |
| Benken | 545.16 | Rock matrix | Whole rock | Dogger | 0.70784 [1] | 179 [1] |
| Benken | 571.55 | Rock matrix | Whole rock | Dogger | 0.70773 [1] | 256 [1] |
| Benken | 582.09 | Rock matrix | Whole rock | Dogger | 0.70789 [1] | 163 [1] |
| Benken | 635.67 | Rock matrix | Whole rock | Dogger | 0.70818 [1] | 134 [1] |
| Benken | 645.05 | Rock matrix | Whole rock | Dogger | 0.70808 [1] | 203 [1] |

Continuation of Table A.2

| Locality | Sample depth (m) | Phase | Occurrence | Unit | $^{87}Sr/^{86}Sr$ | Sr (µg/g) |
|---|---|---|---|---|---|---|
| Benken | 657.62 | Rock matrix | Whole rock | Liassic | 0.70747 [1] | 678 [1] |
| Benken | 683.27 | Rock matrix | Whole rock | Liassic | 0.70911 [1] | 112 [1] |
| Benken | 702.37 | Rock matrix | Whole rock | Keuper | 0.70902 [1] | 1033 [1] |
| Benken | 712.76 | Rock matrix | Whole rock | Keuper | 0.70864 [1] | 513 [1] |
| Benken | 713.26 | Rock matrix | Whole rock | Keuper | 0.70879 [1] | 1099 [1] |
| Benken | 730.76 | Rock matrix | Whole rock | Keuper | 0.70889 [1] | 88 [1] |
| Böttstein | 123–202 | Water | Groundwater | UMK | 0.70968 [2] | 11 [2] |
| Benken | 813–826 | Water | Groundwater | UMK | 0.70830 [1] | 6.5 [1] |
| Weiach | 822–896 | Water | Groundwater | UMK | 0.70881 [2] | 7.9 [2] |
| Schafisheim | 1227–1293 | Water | Groundwater | UMK | 0.70919 [2] | 17.2 [2] |
| Riniken | 617–696 | Water | Groundwater | UMK | 0.70924 [2] | 13.6 [2] |
| Leuggern | 53–96 | Water | Groundwater | UMK | 0.70867 [2] | 3.1 [2] |
| Weiach | 981–989 | Water | Groundwater | Buntsandstein | 0.71652 [2] | 11.3 [3] |
| Böttstein | 305–319 | Water | Groundwater | Buntsandstein | 0.71455 [2] | 0.9 [2] |
| Schafisheim | 1476–1500 | Water | Groundwater | Buntsandstein | 0.71343 [2] | 17.8 [3] |
| Schafisheim | 1564–1577 | Water | Groundwater | Buntsandstein | 0.71442 [2] | 0.5 [2] |
| Riniken | 793–820 | Water | Groundwater | Buntsandstein | 0.71506 [2] | 16.0 [3] |
| Kaisten | 617–696 | Water | Groundwater | Buntsandstein | 0.71386 [2] | 12.6 [2] |
| Leuggern | 208–227 | Water | Groundwater | Buntsandstein | 0.71629 [2] | 0.7 [2] |
| Benken | 974–983 | Water | Groundwater | Buntsandstein | 0.71485 [1] | 0.3 [1] |
| Böttstein | 393–405 | Water | Groundwater | CB | 0.71730 [2] | 0.4 [2] |
| Böttstein | 618–624 | Water | Groundwater | CB | 0.71752 [2] | 0.1 [3] |
| Weiach | 2211–2224 | Water | Groundwater | CB | 0.71671 [2] | 4.7 [2] |
| Schafisheim | 1883–1892 | Water | Groundwater | CB | – | 16.2 [3] |
| Leuggern | 507–568 | Water | Groundwater | CB | 0.71672 [2] | 0.5 [2] |
| Leuggern | 702–709 | Water | Groundwater | CB | 0.71656 [2] | 0.5 [2] |
| Leuggern | 1179–1227 | Water | Groundwater | CB | 0.71729 [2] | 0.3 [2] |
| Leuggern | 1427–1439 | Water | Groundwater | CB | 0.71741 [2] | 0.7 [2] |
| Leuggern | 1642–1688 | Water | Groundwater | CB | 0.71747 [2] | 0.4 [2] |
| Kaisten | 475–489 | Water | Groundwater | CB | 0.71722 [2] | 1.5 [3] |
| Kaisten | 816–822 | Water | Groundwater | CB | 0.71767 [2] | 1.3 [2] |
| Kaisten | 1021–1040 | Water | Groundwater | CB | 0.71778 [2] | 1.4 [2] |
| Kaisten | 1238–1305 | Water | Groundwater | CB | 0.71711 [2] | 1.0 [2] |
| Bruche | – | Water | River water | CB dominated | 0.71051 [4] | 0.04 [4] |
| Geissen | – | Water | River water | CB dominated | 0.71639 [4] | 0.03 [4] |
| Weiss | – | Water | River water | CB dominated | 0.71692 [4] | 0.03 [4] |
| Fecht | – | Water | River water | CB dominated | 0.71330 [4] | 0.03 [4] |
| Lauch | – | Water | River water | CB dominated | 0.70906 [4] | 0.04 [4] |
| Thur | – | Water | River water | CB dominated | 0.71015 [4] | 0.03 [4] |
| Doller | – | Water | River water | CB dominated | 0.70913 [4] | 0.03 [4] |
| Murg | – | Water | River water | CB dominated | 0.71414 [4] | 0.02 [4] |
| Kinzig | – | Water | River water | CB dominated | 0.71413 [4] | 0.04 [4] |
| Elz-1 | – | Water | River water | CB dominated | 0.71096 [4] | 0.10 [4] |
| Elz-2 | – | Water | River water | CB dominated | 0.71306 [4] | 0.03 [4] |

Continuation of Table A.2

| Locality | Sample depth (m) | Phase | Occurrence | Unit | $^{87}Sr/^{86}Sr$ | Sr (µg/g) |
|---|---|---|---|---|---|---|
| Vosges | – | Water | Shallow GW | CB | 0.71267 [4] | 0.91 [4] |
| Vosges | – | Water | Shallow GW | CB | 0.71571 [4] | 0.06 [4] |
| Black Forest | – | Water | Shallow GW | CB | 0.71393 [4] | 0.09 [4] |
| Black Forest | – | Water | Shallow GW | CB | 0.71381 [4] | 0.07 [4] |
| Nettenbach | – | Water | Shallow GW | OSM | 0.70963 [5] | – |
| Stahringen | – | Water | Shallow GW | OSM | 0.70961 [5] | – |
| Hemmenhofen | – | Water | Shallow GW | OSM | 0.70949 [5] | – |
| Bankholzen | – | Water | Shallow GW | OSM | 0.70938 [5] | – |
| Horn | 58–82 | Water | Shallow GW | OSM | 0.70929 [5] | – |
| Gundholzen | – | Water | Shallow GW | OSM | 0.70905 [5] | – |
| – | – | Water | Shallow GW | OSM–UMM | 0.7079–0.7091 [6] | – |

TD: Trigonodus Dolomit
HMK: Hauptmuschelkalk
DAG: Dolomit der Anhydritgruppe
CB: Crystalline basement
OSM: Upper Freshwater Molasse
UMM: Lower Seawater Molasse

[1] Nagra [38]
[2] Pearson et al. [20]
[3] Wittwer [61]
[4] Durand et al. [40]
[5] Waber et al. [21]
[6] McArthur et al. [39]

# A3

Table A.3: Compilation of microthermometric analyses of primary fluid inclusions in secondary minerals from various wells across the Swiss Molasse Basin.

| Well | Sample ID | Mineral | Occurrence | Unit | Trapping mode | Analysed assemblages | $T_{trap}$ (° C) | $T_{m,ice}$ (° C) | Salinity (wt.% $NaCl_{eq}$) |
|---|---|---|---|---|---|---|---|---|---|
| Benken | BEN 825.11 | Quartz | Pore-filling | TD | Heterogeneous (aq. liquid + $CH_4$ gas) | 1 | 52 | -22.3 to -0.7 | 1.2–23.9* |
| Benken | BEN 828.14 | Quartz | Pore-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 3 | 41–47 | -21.0 to -6.2 | 9.5–23.0* |
| Schlattingen | SLA 1126.46 | Quartz | Pore-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 6 | 42–58 | -20.9 to -2.1 | 3.5–23.0* |
| Schlattingen | SLA 1127.44 | Quartz | Pore-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 4 | 42–48 | -21.9 to -3.7 | 6.0–23.6* |
| Benken | BEN 866.44 | Calcite | Pore-filling | HMK | Heterogeneous (aq.liquid + $CH_4$ gas) | 5 | 85–88 | -1.9 to -0.2 | 0.4–3.2 |
| Benken | BEN 998.99 | Calcite | Fracture-filling | CB | Heterogeneous (aq.liquid + $CH_4$ gas) | 2 | 55–62 | -28.6 to -20.2 | 22.5–27.8* |
| Schlattingen | SLA 1127.83 | Calcite | Fracture-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 1 | 80 | -1.0 to -0.1 | 0.2–2.7 |
| Schlattingen | SLA 1135.29 | Calcite | Pore-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 1 | 89 | -2.9 to -1.5 | 2.6–4.8 |
| Schlattingen | SLA 1157.34 | Calcite | Pore-filling | HMK | Heterogeneous (aq.liquid + $CH_4$ gas) | 1 | 76 | -3.4 | 5.6 |
| Schlattingen | SLA 1167.88 | Calcite | Fracture-filling | HMK | Heterogeneous (aq.liquid + $CH_4$ gas) | 1 | 78 | -4.0 to -3.1 | 5.1–6.5 |
| Siblingen | SIB 241.60 | Calcite | Fracture-filling | HMK | Heterogeneous (aq.liquid + $CH_4$ gas) | 3 | 65–75 | -0.1 to -1.7 | 0.2–2.9 |
| Siblingen | SIB 1023.62 | Calcite | Fracture-filling | CB | Heterogeneous (aq.liquid + $CH_4$ gas) | 3 | 65–75 | -0.1 to -0.3 | 0.2–0.5 |
| Leuggern | LEU 318.65 | Calcite | Fracture-filling | CB | Heterogeneous (aq.liquid + $CH_4$ gas) | 2 | 85–95 | -28.7 to -21.1 | 23.1–27.8* |
| Böttstein | BOE 150.99 | Calcite | Fracture-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 3 | 51–55 | -12.7 to -17.7 | 16.6–20.7 |
| Bözberg | BOZ 98.52 | Calcite | Fracture-filling | HMK | Heterogeneous (aq.liquid + $CH_4$ gas) | 2 | 68–79 | -23.7 to -15.2 | 18.8–24.9* |
| Schafisheim | SHA 1285.34 | Calcite | Tension gash | HMK | Heterogeneous (aq.liquid + $CH_4$ gas) | 4 | 75–85 | -12.3 to -4.0 | 6.5–16.3 |
| Schafisheim | SHA 1252.77 | Calcite | Pore-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 3 | 52–65 | -22.5 to -5.1 | 8.0–24.1* |
| Schafisheim | SHA 1334.99 | Calcite | Fracture-filling | DAG | Heterogeneous (aq.liquid + $CH_4$ gas) | 1 | 65 | -21.4 to -6.4 | 9.7–23.4* |
| Schafisheim | SHA 1252.38 | Calcite | Pore-filling | TD | Heterogeneous (aq.liquid + $CH_4$ gas) | 1 | 65 | -22.5 to -5.0 | 7.9–24.1* |
| Lindau | LIN 2245.35 | Saddle dolomite | Pore-filling | TD | Homogeneous (aq. liquid) | 6 | 155–161** | -4.8 to -3.1 | 5.1–7.6 |
| Berlingen | BER 2189.11 | Saddle dolomite | Pore-filling | TD | Homogeneous (aq. liquid) | 5 | 152–156** | -4.2 to -2.1 | 3.6–6.7 |

HMK: Hauptmuschelkalk
DAG: Dolomit der Anhydritgruppe
CB: Crystalline basement
$T_{trap}$: Fluid inclusion trapping temperature
$T_{m,ice}$: Final ice melting temperature
Salinities are calculated according to Hall et al. [44]
*: The measured final ice melting temperatures below the eutectic temperature of $NaCl-H_2O$ fluids (-21.2 °C; [44]) indicate that the corresponding parent-water contained other salts beside NaCl. The presence of Ca and Mg in the host rocks point towards additional $CaCl_2$ and $MgCl_2$.
** Pressure corrected fluid inclusion trapping temperatures.

## A4

Table A.4: Results of the oxygen isotope analyses and calculated parent-waters of secondary quartz, calcite and dolomite from various wells across the Swiss Molasse Basin.

| Well | Sample depth (m) | Mineral | Occurrence | Unit | $\delta^{18}O_{mineral}$ (‰ VSMOW) | $T_{trap}$ (° C) | $\delta^{18}O_{parent-water}$ (‰ VSMOW) |
|---|---|---|---|---|---|---|---|
| Benken | 825.11-1 | Quartz | Pore-filling | TD | 27.3 | 41–52 | -4.6 to -2.1 |
| Benken | 825.11-2 | Quartz | Pore-filling | TD | 27.3 | 41–52 | -4.6 to -2.1 |
| Benken | 825.11-3 | Quartz | Pore-filling | TD | 25.9 | 41–52* | -6.0 to -3.5 |
| Benken | 825.11-4 | Quartz | Pore-filling | TD | 25.5 | 41–52 | -6.4 to -3.9 |
| Benken | 828.14-1 | Quartz | Pore-filling | TD | 25.1 | 41–52 | -6.8 to -4.3 |
| Benken | 828.14-2 | Quartz | Pore-filling | TD | 27.3 | 41–52* | -4.6 to -2.1 |
| Benken | 828.14-3 | Quartz | Pore-filling | TD | 26.4 | 41–52 | -5.5 to -3.0 |
| Benken | 828.14-4 | Quartz | Pore-filling | TD | 26.0 | 41–52 | -5.9 to -3.4 |
| Benken | 839.81-1 | Calcite | Pore-filling | TD | 15.2 | 85–88 | -3.6 to -3.2 |
| Benken | 839.81-2 | Calcite | Pore-filling | TD | 15.0 | 85–88 | -3.8 to -3.4 |
| Benken | 833.87 | Calcite | Pore-filling | TD | 15.5 | 85–88 | -3.3 to -3.0 |
| Benken | 866.41 | Calcite | Pore-filling | HMK | 14.4 | 85–88 | -4.4 to -4.0 |
| Benken | 866.42 | Calcite | Pore-filling | HMK | 15.0 | 85–88 | -3.8 to -3.4 |
| Benken | 866.44 | Calcite | Pore-filling | HMK | 14.0 | 85–88* | -4.8 to -4.4 |
| Benken | 866.45 | Calcite | Pore-filling | HMK | 15.3 | 85–88 | -3.5 to -3.1 |
| Benken | 866.46 | Calcite | Pore-filling | HMK | 14.0 | 85–88 | -4.8 to -4.4 |
| Benken | 866.47 | Calcite | Pore-filling | HMK | 15.5 | 85–88 | -3.3 to -2.9 |
| Benken | 866.49 | Calcite | Pore-filling | HMK | 13.9 | 85–88 | -4.9 to -4.5 |
| Benken | 998.99 | Calcite | Fracture-filling | CB | 22.0 | 55–62* | -0.9 to 0.1 |
| Bözberg | 98.52 | Calcite | Fracture-filling | HMK | 24.3 | 68–79 | 3.3 to 4.8 |
| Bözberg | 105.20 | Calcite | Fracture-filling | HMK | 19.6 | 68–79* | -1.4 to 0.1 |
| Bözberg | 135.69 | Calcite | Fracture-filling | DAG | 18.4 | 68–79 | -2.6 to -1.1 |
| Schlattingen | 1157.34 | Calcite | Pore-filling | HMK | 15.2 | 76* | -4.7 |
| Schlattingen | 1167.88 | Calcite | Fracture-filling | HMK | 14.8 | 78* | -4.9 |
| Schlattingen | 1168.31 | Calcite | Pore-filling | HMK | 14.1 | 76–89 | -5.9 to -4.3 |
| Schlattingen | 1170.48 | Calcite | Fracture-filling | DAG | 13.9 | 76–89 | -6.0 to -4.4 |
| Schlattingen | 1171.00 | Calcite | Fracture-filling | DAG | 14.7 | 76–89 | -5.2 to -3.6 |
| Schlattingen | 1177.10 | Calcite | Pore-filling | DAG | 13.5 | 76–89 | -6.4 to -4.8 |
| Schafisheim | 1252.77 | Calcite | Fracture-filling | TD | 26.2 | 52–65* | 2.8 to 4.8 |
| Schafisheim | 1285.34 | Calcite | Tension gash | HMK | 24.6 | 75–85* | 4.6 to 5.9 |
| Schafisheim | 1327.06 | Calcite | Fracture-filling | DAG | 25.8 | 65 | 4.3 |
| Schafisheim | 1330.70 | Calcite | Fracture-filling | DAG | 22.6 | 65 | 1.1 |
| Schafisheim | 1334.99 | Calcite | Fracture-filling | DAG | 24.1 | 65* | 2.7 |
| Böttstein | 146.31 | Calcite | Pore-filling | TD | 17.8 | 51–55 | -5.8 to -5.2 |
| Böttstein | 150.99 | Calcite | Fracture-filling | TD | 20.9 | 51–55* | -2.7 to -2.1 |
| Böttstein | 196.94 | Calcite | Pore-filling | HMK | 16.3 | 51–55 | -7.2 to -6.6 |
| Siblingen | 244.72 | Calcite | Pore-filling | DAG | 15.6 | 65–75 | -5.8 to -4.5 |
| Siblingen | 241.60 | Calcite | Fracture-filling | DAG | 17.4 | 65–75* | -4.1 to -2.7 |
| Siblingen | 209.95 | Calcite | Pore-filling | HMK | 18.9 | 65–75 | -2.5 to -1.1 |
| Siblingen | 242.37 | Calcite | Fracture-filling | DAG | 17.1 | 65–75 | -4.3 to -2.9 |
| Lindau | 2250.14 | Saddle dolomite | Pore-filling | TD | 23.6 | >141–147 | 8.5 to 9.0 |
| Lindau | 2232.64 | Saddle dolomite | Pore-filling | TD | 21.2 | >141–147 | 6.1 to 6.6 |
| Lindau | 2245.35 | Saddle dolomite | Pore-filling | TD | 21.9 | >141–147* | 6.7 to 7.2 |
| Lindau | 2249.42 | Saddle dolomite | Pore-filling | TD | 23.5 | >141–147 | 8.3 to 8.8 |

Continuation of Table A.4

| Well | Sample depth (m) | Mineral | Occurrence | Unit | $\delta^{18}O_{mineral}$ (‰ VSMOW) | $T_{trap}$ (° C) | $\delta^{18}O_{parent\text{-}water}$ (‰ VSMOW) |
|---|---|---|---|---|---|---|---|
| Berlingen | 2179.87 | Saddle dolomite | Pore-filling | TD | 13.7 | >138–142 | -1.8 to -1.4 |
| Berlingen | 2180.64 | Saddle dolomite | Pore-filling | TD | 13.8 | >138–142 | -1.6 to -1.3 |
| Berlingen | 2189.45 | Saddle dolomite | Pore-filling | TD | 13.5 | >138–142 | -2.0 to -1.6 |
| Berlingen | 2181.37 | Saddle dolomite | Pore-filling | TD | 15.0 | >138–142 | -0.4 to -0.1 |
| Berlingen | 2189.11 | Saddle dolomite | Pore-filling | TD | 14.6 | >138–142* | -0.9 to -0.5 |
| Siblingen | 1023.62 | Calcite | Fracture-filling | CB | 11.9 | 65–75* | -9.5 to -8.2 |
| Siblingen | 770.36 | Calcite | Fracture-filling | CB | 11.5 [1] | 65–75 | -9.9 to -8.5 |
| Siblingen | 1162.67 | Calcite | Fracture-filling | CB | 12.5 [1] | 65–75 | -9.0 to -7.6 |
| Siblingen | 1249.04 | Calcite | Fracture-filling | CB | 12.0 [1] | 65–75 | -9.4 to -8.1 |
| Siblingen | 1371.68 | Calcite | Fracture-filling | CB | 10.7 [1] | 65–75 | -10.7 to -9.3 |
| Leuggern | 318.65 | Calcite | Fracture-filling | CB | 20.8 | 85–95* | 2.0 to 3.2 |
| Leuggern | 863.35 | Calcite | Fracture-filling | CB | 12.4 [2] | 65–75 | -9.1 to -7.7 |
| Leuggern | 949.88 | Calcite | Fracture-filling | CB | 14.1 [2] | 65–75 | -7.3 to -5.9 |
| Leuggern | 1046.05 | Calcite | Fracture-filling | CB | 11.3 [2] | 65–75 | -10.2 to -8.8 |
| Leuggern | 1188.00 | Calcite | Fracture-filling | CB | 12.5 [2] | 65–75 | -8.9 to -7.5 |
| Leuggern | 1197.42 | Calcite | Fracture-filling | CB | 11.9 [2] | 65–75 | -9.5 to -8.2 |
| Leuggern | 1212.7 | Calcite | Fracture-filling | CB | 11.2 [2] | 65–75 | -10.2 to -8.9 |
| Leuggern | 1298.18 | Calcite | Fracture-filling | CB | 10.8 [2] | 65–75 | -10.7 to -9.3 |
| Kaisten | 799.88 | Calcite | Fracture-filling | CB | 14.2 [3] | 65–75 | -7.3 to -5.9 |
| Kaisten | 819.67 | Calcite | Fracture-filling | CB | 14.4 [3] | 65–75 | -7.0 to -5.7 |
| Kaisten | 834.28 | Calcite | Fracture-filling | CB | 13.7 [3] | 65–75 | -7.8 to -6.4 |
| Kaisten | 846.88 | Calcite | Fracture-filling | CB | 15.0 [3] | 65–75 | -6.4 to -5.0 |
| Kaisten | 918.72 | Calcite | Fracture-filling | CB | 13.0 [3] | 65–75 | -8.5 to -7.1 |
| Kaisten | 1048.8 | Calcite | Fracture-filling | CB | 14.6 [3] | 65–75 | -6.8 to -5.5 |
| Kaisten | 1205.11 | Calcite | Fracture-filling | CB | 11.7 [3] | 65–75 | -9.7 to -8.3 |
| Kaisten | 1273.94 | Calcite | Fracture-filling | CB | 14.5 [3] | 65–75 | -6.9 to -5.6 |
| Kaisten | 1273.94 | Calcite | Fracture-filling | CB | 10.8 [3] | 65–75 | -10.6 to -9.3 |

TD: Trigonodus Dolomit
HMK: Hauptmuschelkalk
DAG: Dolomit der Anhydritgruppe
CB: Crystalline basement
$T_{trap}$: Fluid inclusion trapping temperature
*: Samples with constraints on precipitation temperature from fluid inclusion studies. Those temperatures provide the basis for calculating the parent-water of samples without temperature constraints from fluid inclusion studies.
[1] Nagra [51]
[2] Peters et al. [47]
[3] Nagra [50]

# A5

Table A.5: Results of the oxygen and hydrogen isotope analyses of secondary kaolinite and calculated parent-waters from various wells across the Swiss Molasse Basin.

| Well | Sample depth (m) | Phase | Occurrence | Unit | $\delta^{18}O_{mineral}$ (‰ VSMOW) | $\delta^{2}H_{mineral}$ (‰ VSMOW) | $T_{precip.}$ (° C) | $\delta^{18}O_{parent\text{-}water}$ (‰ VSMOW) | $\delta^{2}H_{parent\text{-}water}$ (‰ VSMOW) |
|---|---|---|---|---|---|---|---|---|---|
| Benken | 811.36 | Kaolinite | Pore-filling | TD | 10.00 | -82.0 | 85–88 | -4.77 to -4.41 | -57.4 to -57.2 |
| Benken | 833.87 | Kaolinite | Pore-filling | TD | 9.80 | -80.5 | 85–88 | -4.97 to -4.61 | -55.9 to -55.7 |
| Benken | 839.81 | Kaolinite | Pore-filling | TD | 9.30 | -80.2 | 85–88 | -5.47 to -5.11 | -55.6 to -55.4 |
| Benken | 839.81 | Kaolinite | Pore-filling | TD | 10.19 | -78.5 | 85–88 | -4.58 to -4.22 | -53.9 to -53.7 |
| Benken | 811.36 | Kaolinite | Pore-filling | TD | 10.23 | -79.9 | 85–88 | -4.54 to -4.18 | -55.3 to -55.1 |
| Benken | 826.87 | Kaolinite | Pore-filling | TD | 10.61 | -87.5 | 85–88 | -4.16 to -3.8 | -62.9 to -62.7 |
| Schlattingen | 1130.94 | Kaolinite | Pore-filling | TD | 9.36 | -82.0 | 76–89 | -6.53 to -4.93 | -56.5 to -57.3 |
| Schlattingen | 1127.44 | Kaolinite | Pore-filling | TD | 9.17 | -85.5 | 76–89 | -6.72 to -5.12 | -61.0 to -59.8 |
| Schlattingen | 1130.50 | Kaolinite | Pore-filling | TD | 8.28 | -88.5 | 76–89 | -7.61 to -6.01 | -64.0 to -62.8 |
| Weiach | 843.36 | Kaolinite | Pore-filling | TD | 10.90 | -86.5 | 76–89 | -4.99 to -3.39 | -62.0 to -60.8 |
| Schlattingen | 1159.50 | Kaolinite | Pore-filling | HMK | 10.14 | -83.0 | 76–89 | -5.75 to -4.15 | -58.5 to -57.3 |
| Schlattingen | 1164.33 | Kaolinite | Pore-filling | HMK | 9.46 | -91.0 | 76–89 | -6.43 to -4.83 | -66.5 to -65.3 |
| Siblingen | 401.82 | Kaolinite | Fracture-filling | CB | | -91.9 | 70–80 | | -66.5 to -65.5 |
| Siblingen | 456.34 | Kaolinite | Fracture-filling | CB | | -94.1 | 71–81 | | -69.5 to -68.6 |
| Siblingen | 659.67 | Kaolinite | Fracture-filling | CB | | -95.6 | 78–88 | | -71.1 to -70.1 |
| Siblingen | 701.29 | Kaolinite | Fracture-filling | CB | | -91.5 | 79–89 | | -67.0 to -66.0 |
| Siblingen | 828.11 | Kaolinite | Fracture-filling | CB | | -91.4 | 83–93 | | -67.3 to -66.3 |
| Siblingen | 915.58 | Kaolinite | Fracture-filling | CB | | -90.3 | 85–95 | | -66.1 to -65.2 |
| Siblingen | 922.95 | Kaolinite | Fracture-filling | CB | | -89.3 | 85–95 | | -65.4 to -64.4 |

TD: Trigonodus Dolomit
HMK: Hauptmuschelkalk
CB: Crystalline basement
$T_{precip.}$: Precipitation temperature of kaolinite derived from fluid inclusion studies in coeval calcite

## A6

Table A.6: Results of the sulphur isotope analyses of anhydrite nodules and secondary pore- and fracture-filling anhydrite in the Muschelkalk and the overlying Keuper.

| Well | Sample depth (m) | Mineral | Occurrence | Unit | $\delta^{34}S_{anyhdrite}$ (‰ VCDT) |
|---|---|---|---|---|---|
| Benken | 931.75 M | Anhydrite | Rock | Sulfatschichten | 18.8 [1] |
| Weiach | 910.15 | Anhydrite | Massive bed | Sulfatschichten | 18.5 [2] |
| Böttstein | 241.16 | Anhydrite | Rock | Sulfatschichten | 19.5 [2] |
| Schafisheim | 1294.17 | Anhydrite | Massive bed | DAG | 18.6 |
| Schafisheim | 1295.76 | Anhydrite | Massive bed | DAG | 18.5 |
| Weiach | 824.85 | Anhydrite | Blocky anhydrite, nodule | TD | 19.2 [2] |
| Weiach | 828.72 | Anhydrite | Felted anhydrite, nodule | TD | 18.7 [2] |
| Schlattingen | 1121.87 | Anhydrite | Nodule | TD | 19.9 |
| Schlattingen | 1133.43 | Anhydrite | Nodule | TD | 19.8 |
| Schafisheim | 1234.67 | Anhydrite | Massive bed | TD | 18.0 |
| Benken | 748.18 | Anhydrite | Nodule | Gipskeuper | 12.5 [1] |
| Benken | 766.51 | Anhydrite | Bed | Gipskeuper | 13.8 [1] |
| Böttstein | 59.37 | Gypsum | Nodule | Gipskeuper | 14.3 [2] |
| Böttstein | 59.00 | Gypsum | Satin spar | Gipskeuper | 14.0 [2] |
| Böttstein | 80.00 | Gypsum | Satin spar | Gipskeuper | 14.0 [2] |
| Böttstein | 88.90 | Anhydrite | Pseudom. after satin spar | Gipskeuper | 15.0 [2] |
| Böttstein | 115.50 | Gypsum | Interlayered with dolomite | Gipskeuper | 15.9 [2] |
| Schafisheim | 1189.60 | Anhydrite | Bed | Gipskeuper | 14.4 |
| Schafisheim | 1207.30 | Anhydrite | Bed | Gipskeuper | 14.9 |
| Schafisheim | 1334.99 | Anhydrite | Fracture-filling | HMK | 18.9 |
| Schafisheim | 1329.20 | Anhydrite | Fracture-filling | HMK | 17.7 [2] |
| Böttstein | 158.23 | Anhydrite | Pore-filling | HMK | 19.8 [2] |
| Schlattingen | 1116.66 | Anhydrite | Fracture-filling | TD | 18.8 |
| Schlattingen | 1135.58 | Anhydrite | Pore-filling | TD | 20.2 |
| Schlattingen | 1136.98 | Anhydrite | Pore-filling | TD | 20.4 |
| Schlattingen | 1135.29 | Anhydrite | Pore-filling | TD | 17.5 |
| Schlattingen | 1140.15 | Anhydrite | Pore-filling | TD | 17.3 |
| Schafisheim | 1231.47 | Anhydrite | Pore-filling | TD | 17.8 |
| Schafisheim | 1234.38 | Anhydrite | Pore-filling | TD | 17.6 |
| Schafisheim | 1228.45 | Anhydrite | Fracture-filling | TD | 18.3 |
| Schafisheim | 1230.09 | Anhydrite | Pore-filling | TD | 17.3 |
| Berlingen | 2184.87 | Anhydrite | Fracture-filling | TD | 17.8 |
| Berlingen | 2182.08 | Anhydrite | Fracture-filling | TD | 18.6 |
| Schlattingen | 1116.66 | Anhydrite | Fracture-filling | TD | 19.5 |
| Schlattingen | 1136.98 | Anhydrite | Pore-filling | TD | 19.2 |
| Benken | 771.51 | Anhydrite | Fracture-filling | Keuper | 14.4 [1] |
| Benken | 730.76 | Anhydrite | Fracture-filling | Keuper | 13.5 [1] |

TD: Trigonodus Dolomit
HMK: Hauptmuschelkalk
DAG: Dolomit der Anhydritgruppe
[1] Nagra [38]
[2] Pearson et al. [20]

Table A.7: Results of the LA-ICP-MS analyses of secondary calcites from the wells at Benken, Schlattingen, Siblingen and Leuggern.

| Sample/ Spot | U (ppm) | $^{206}Pb$ (ppm) | Th/U | $^{207}Pb/^{235}U$ | 1σ | $^{206}Pb/^{238}U$ | 1σ | Err. correl. | Model age (Ma) | 1σ | $^{207}Pb/^{235}U$ Age (Ma) | 1σ | $^{206}Pb/^{238}U$ | 1σ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BEN839.81** | | | | | | | | | | | | | | |
| **NIST612 - 213 nm** | | | | | | | | | | | | | | |
| BEN839-1 | 0.061 | . | 0.1 | 0.150235 | 0.088 | 0.00534 | 0.0011 | 0.36702 | 27 | 8 | 34 | 7 | 142 | 75 |
| BEN839-2 | 0.274 | 0.002 | 0.11 | 0.598128 | 0.092 | 0.00548 | 0.0005 | 0.54445 | 2 | 4 | 35 | 3 | 476 | 57 |
| BEN839-12 | 0.758 | 0.007 | 0.02 | 0.610677 | 0.043 | 0.00865 | 0.0003 | 0.49423 | 23 | 2 | 56 | 2 | 484 | 27 |
| BEN839-3 | 0.215 | 0.002 | 0.13 | 0.82216 | 0.106 | 0.01002 | 0.0007 | 0.51546 | 19 | 6 | 64 | 4 | 609 | 58 |
| BEN839-14 | 0.656 | 0.009 | 0.02 | 1.286619 | 0.071 | 0.01305 | 0.0004 | 0.54032 | 12 | 4 | 84 | 2 | 840 | 31 |
| BEN839-23 | 0.702 | 0.009 | 0.04 | 1.277292 | 0.089 | 0.0133 | 0.0005 | 0.53919 | 15 | 4 | 85 | 3 | 836 | 39 |
| BEN839-8 | 0.385 | 0.005 | 0.03 | 1.383389 | 0.099 | 0.01422 | 0.0006 | 0.54044 | 15 | 5 | 91 | 4 | 882 | 42 |
| BEN839-13 | 0.617 | 0.01 | 0.02 | 1.670032 | 0.087 | 0.01622 | 0.0005 | 0.54882 | 11 | 4 | 104 | 3 | 997 | 33 |
| BEN839-15 | 0.639 | 0.01 | 0.02 | 1.640584 | 0.081 | 0.0164 | 0.0004 | 0.54564 | 14 | 4 | 105 | 3 | 986 | 31 |
| BEN839-18 | 0.696 | 0.013 | 0.02 | 1.651514 | 0.076 | 0.0186 | 0.0005 | 0.53468 | 28 | 4 | 119 | 3 | 990 | 29 |
| BEN839-21 | 0.447 | 0.009 | 0.03 | 1.918666 | 0.129 | 0.01944 | 0.0007 | 0.54913 | 18 | 6 | 124 | 5 | 1088 | 44 |
| BEN839-5 | 0.072 | 0.002 | 0.03 | 2.423535 | 0.31 | 0.02563 | 0.0018 | 0.54882 | 30 | 16 | 163 | 11 | 1250 | 89 |
| BEN839-22 | 0.679 | 0.018 | 0.02 | 2.775678 | 0.111 | 0.02648 | 0.0006 | 0.56348 | 15 | 5 | 168 | 4 | 1349 | 30 |
| BEN839-16 | 0.434 | 0.015 | 0.03 | 3.494894 | 0.24 | 0.03506 | 0.0014 | 0.5638 | 31 | 12 | 222 | 8 | 1526 | 53 |
| BEN839-19 | 0.668 | 0.025 | 0.02 | 4.106037 | 0.141 | 0.03806 | 0.0008 | 0.57753 | 15 | 7 | 241 | 5 | 1656 | 28 |
| BEN839-10 | 0.836 | 0.039 | 0.04 | 4.932833 | 0.132 | 0.04634 | 0.0007 | 0.58373 | 22 | 6 | 292 | 4 | 1808 | 22 |
| BEN839-4 | 0.178 | 0.009 | 0.1 | 5.811576 | 0.356 | 0.05301 | 0.0019 | 0.59152 | 15 | 17 | 333 | 12 | 1948 | 52 |
| BEN839-9 | 0.715 | 0.045 | 0.02 | 7.09993 | 0.161 | 0.06263 | 0.0009 | 0.6049 | 4 | 7 | 392 | 5 | 2124 | 20 |
| BEN839-24 | 0.556 | 0.035 | 0.03 | 6.777602 | 0.199 | 0.06264 | 0.0011 | 0.60059 | 23 | 9 | 392 | 7 | 2083 | 26 |
| BEN839-17 | 0.484 | 0.047 | 0.02 | 10.80853 | 0.276 | 0.09673 | 0.0016 | 0.62907 | 16 | 13 | 595 | 9 | 2507 | 24 |
| BEN839-20 | 0.671 | 0.08 | 0.02 | 12.94146 | 0.267 | 0.11919 | 0.0016 | 0.64303 | 42 | 12 | 726 | 9 | 2675 | 19 |
| BEN839-11 | 0.53 | 0.082 | 0.08 | 17.25825 | 0.445 | 0.15401 | 0.0026 | 0.6664 | 22 | 20 | 923 | 15 | 2949 | 25 |
| BEN839-7 | 0.405 | 0.081 | 0.02 | 22.75651 | 0.5 | 0.20003 | 0.003 | 0.69217 | 8 | 20 | 1175 | 16 | 3217 | 21 |
| BEN839-6 | 0.165 | 0.09 | 0.03 | 61.4615 | 1.368 | 0.54715 | 0.0097 | 0.79866 | 69 | 49 | 2813 | 40 | 4198 | 22 |

Continuation of Table A.7

| Sample/ Spot | U (ppm) | $^{206}Pb$ (ppm) | Th/U | $^{207}Pb/^{235}U$ | 1σ | $^{206}Pb/^{238}U$ | 1σ | Err. correl. | Model age (Ma) | 1σ | $^{207}Pb/^{235}U$ Age (Ma) | 1σ | $^{206}Pb/^{238}U$ | 1σ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BEN840.10** | | | | | | | | | | | | | | |
| **NIST612 - 213 nm** | | | | | | | | | | | | | | |
| BEN840-10 | 0.618 | 0.005 | 0.06 | 0.577 | 0.050 | 0.0084 | 0.0004 | 0.4907 | 23 | 3 | 54 | 2 | 462 | 32 |
| BEN840-9.2 | 0.136 | 0.001 | 0.10 | 0.641 | 0.047 | 0.0085 | 0.0003 | 0.5033 | 20 | 3 | 55 | 2 | 503 | 29 |
| BEN840-11.2 | 0.179 | 0.002 | 0.07 | 0.753 | 0.047 | 0.0085 | 0.0003 | 0.5237 | 13 | 2 | 54 | 2 | 570 | 27 |
| BEN840-10.2 | 0.122 | 0.001 | 0.07 | 0.950 | 0.057 | 0.0108 | 0.0003 | 0.5251 | 17 | 3 | 69 | 2 | 678 | 29 |
| BEN840-11.3 | 0.121 | 0.001 | 0.07 | 0.991 | 0.059 | 0.0106 | 0.0003 | 0.5326 | 13 | 3 | 68 | 2 | 699 | 30 |
| BEN840-11.4 | 0.185 | 0.002 | 0.13 | 1.140 | 0.062 | 0.0123 | 0.0004 | 0.5333 | 16 | 3 | 79 | 2 | 773 | 29 |
| BEN840-10.5 | 0.13 | 0.002 | 0.06 | 1.227 | 0.066 | 0.0123 | 0.0004 | 0.5423 | 10 | 3 | 79 | 2 | 813 | 30 |
| BEN840-11 | 0.701 | 0.010 | 0.07 | 1.412 | 0.078 | 0.0145 | 0.0004 | 0.5404 | 15 | 4 | 93 | 3 | 894 | 32 |
| BEN840-10.3 | 0.116 | 0.002 | 0.07 | 1.851 | 0.093 | 0.0189 | 0.0005 | 0.5470 | 18 | 5 | 121 | 3 | 1064 | 33 |
| BEN840-9 | 0.508 | 0.012 | 0.13 | 2.301 | 0.114 | 0.0233 | 0.0006 | 0.5507 | 22 | 6 | 149 | 4 | 1213 | 35 |
| BEN840-12 | 0.514 | 0.012 | 0.02 | 2.555 | 0.143 | 0.0243 | 0.0008 | 0.5596 | 14 | 7 | 155 | 5 | 1288 | 40 |
| BEN840-11.5 | 0.131 | 0.004 | 0.04 | 2.643 | 0.102 | 0.0271 | 0.0006 | 0.5554 | 27 | 5 | 172 | 4 | 1313 | 28 |
| BEN840-10.4 | 0.137 | 0.004 | 0.05 | 2.664 | 0.100 | 0.0262 | 0.0005 | 0.5588 | 20 | 5 | 167 | 3 | 1319 | 27 |
| BEN840-9.3 | 0.074 | 0.002 | 0.13 | 3.200 | 0.166 | 0.0319 | 0.0009 | 0.5626 | 27 | 8 | 202 | 6 | 1457 | 39 |
| BEN840-6 | 0.055 | 0.002 | 0.04 | 4.358 | 0.596 | 0.0410 | 0.0032 | 0.5754 | 20 | 28 | 259 | 20 | 1704 | 109 |
| BEN840-7 | 0.205 | 0.009 | 0.02 | 4.644 | 0.306 | 0.0423 | 0.0016 | 0.5803 | 12 | 14 | 267 | 10 | 1757 | 54 |
| BEN840-4 | 0.174 | 0.010 | 0.02 | 6.689 | 0.353 | 0.0600 | 0.0019 | 0.5965 | 11 | 16 | 376 | 11 | 2071 | 46 |
| BEN840-8 | 0.785 | 0.087 | 0.01 | 12.664 | 0.257 | 0.1105 | 0.0014 | 0.6379 | -1 | 10 | 675 | 8 | 2655 | 19 |
| BEN840-5 | 0.354 | 0.046 | 0.04 | 14.028 | 0.353 | 0.1308 | 0.0021 | 0.6429 | 56 | 16 | 793 | 12 | 2752 | 24 |
| | | | | | | | | | | | | | | |
| **BEN853.92** | | | | | | | | | | | | | | |
| **NIST612 - 193 nm** | | | | | | | | | | | | | | |
| BEN853.82-12-24 | 2.136 | 0.004 | 0.06 | 0.019 | 0.006 | 0.0019 | 0.0001 | 0.2108 | 12 | 1 | 12 | 1 | 19 | 6 |
| BEN853.82-12-26 | 2.208 | 0.005 | 0.07 | 0.023 | 0.007 | 0.0021 | 0.0001 | 0.2201 | 13 | 1 | 13 | 1 | 23 | 7 |
| BEN853.82-12-23 | 1.648 | 0.004 | 0.06 | 0.024 | 0.008 | 0.0022 | 0.0002 | 0.2173 | 14 | 1 | 14 | 1 | 24 | 8 |
| BEN853.82-12-20 | 1.941 | 0.004 | 0.06 | 0.030 | 0.009 | 0.0018 | 0.0001 | 0.2619 | 11 | 1 | 12 | 1 | 30 | 9 |

Continuation of Table A.7

| Sample/<br>Spot | U<br>(ppm) | $^{206}Pb$<br>(ppm) | Th/U | $^{207}Pb/^{235}U$ | 1σ | $^{206}Pb/^{238}U$ | 1σ | Err.<br>correl. | Model age<br>(Ma) | 1σ | $^{207}Pb/^{235}U$<br>Age (Ma) | 1σ | $^{206}Pb/^{238}U$ | 1σ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BEN853.82-12-21 | 2.649 | 0.005 | 0.06 | 0.033 | 0.008 | 0.0019 | 0.0001 | 0.2697 | 11 | 1 | 12 | 1 | 33 | 8 |
| BEN853.82-12-28 | 1.518 | 0.003 | 0.07 | 0.037 | 0.011 | 0.0019 | 0.0002 | 0.2796 | 11 | 1 | 12 | 1 | 36 | 11 |
| BEN853.82-12-30 | 2.021 | 0.005 | 0.07 | 0.036 | 0.009 | 0.0022 | 0.0001 | 0.2588 | 13 | 1 | 14 | 1 | 36 | 9 |
| BEN853.82-12-19 | 1.726 | 0.004 | 0.06 | 0.041 | 0.011 | 0.0021 | 0.0002 | 0.2806 | 12 | 1 | 14 | 1 | 40 | 11 |
| BEN853.82-12-22 | 2.054 | 0.004 | 0.06 | 0.040 | 0.010 | 0.0019 | 0.0001 | 0.2886 | 11 | 1 | 12 | 1 | 40 | 9 |
| BEN853.82-12-13 | 1.644 | 0.003 | 0.06 | 0.045 | 0.013 | 0.0019 | 0.0002 | 0.3060 | 10 | 1 | 12 | 1 | 45 | 12 |
| BEN853.82-12-5 | 1.963 | 0.004 | 0.07 | 0.046 | 0.011 | 0.0021 | 0.0001 | 0.2948 | 12 | 1 | 14 | 1 | 46 | 11 |
| BEN853.82-12-4 | 1.324 | 0.003 | 0.07 | 0.049 | 0.014 | 0.0022 | 0.0002 | 0.2990 | 12 | 1 | 14 | 1 | 49 | 14 |
| BEN853.82-12-25 | 1.8 | 0.004 | 0.07 | 0.054 | 0.012 | 0.0025 | 0.0002 | 0.2962 | 14 | 1 | 16 | 1 | 53 | 12 |
| BEN853.82-12-14 | 1.069 | 0.003 | 0.07 | 0.058 | 0.018 | 0.0026 | 0.0002 | 0.3001 | 14 | 2 | 16 | 2 | 57 | 17 |
| BEN853.82-12-15 | 1.534 | 0.003 | 0.06 | 0.062 | 0.014 | 0.0021 | 0.0002 | 0.3333 | 11 | 1 | 14 | 1 | 61 | 14 |
| BEN853.82-12-29 | 1.703 | 0.003 | 0.07 | 0.063 | 0.015 | 0.0019 | 0.0002 | 0.3518 | 9 | 1 | 12 | 1 | 62 | 15 |
| BEN853.82-12-1 | 1.669 | 0.004 | 0.07 | 0.073 | 0.015 | 0.0022 | 0.0002 | 0.3483 | 11 | 1 | 14 | 1 | 71 | 14 |
| BEN853.82-12-16 | 1.567 | 0.004 | 0.06 | 0.087 | 0.017 | 0.0026 | 0.0002 | 0.3511 | 12 | 1 | 17 | 1 | 85 | 16 |
| BEN853.82-12-17 | 1.201 | 0.003 | 0.07 | 0.090 | 0.021 | 0.0022 | 0.0002 | 0.3772 | 10 | 1 | 14 | 1 | 88 | 19 |
| BEN853.82-12-27 | 0.764 | 0.002 | 0.07 | 0.125 | 0.033 | 0.0026 | 0.0003 | 0.4013 | 10 | 2 | 16 | 2 | 119 | 29 |
| BEN853.82-12-3 | 0.985 | 0.004 | 0.18 | 0.177 | 0.047 | 0.0036 | 0.0004 | 0.4040 | 14 | 3 | 23 | 2 | 166 | 40 |
| BEN853.82-12-18 | 1.155 | 0.004 | 0.10 | 0.239 | 0.044 | 0.0033 | 0.0003 | 0.4532 | 9 | 2 | 21 | 2 | 218 | 36 |
| BEN853.82-12-8 | 2.172 | 0.035 | 0.14 | 1.602 | 0.094 | 0.0159 | 0.0005 | 0.5029 | 13 | 5 | 102 | 3 | 971 | 36 |
| BEN853.82-12-2 | 2.094 | 0.130 | 0.10 | 6.704 | 0.193 | 0.0621 | 0.0009 | 0.5290 | 24 | 10 | 388 | 6 | 2073 | 25 |
| BEN853.82-12-6 | 1.731 | 0.114 | 0.08 | 7.273 | 0.194 | 0.0660 | 0.0009 | 0.5331 | 17 | 10 | 412 | 6 | 2145 | 24 |
| | | | | | | | | | | | | | | |
| **LEU54.78** | | | | | | | | | | | | | | |
| **NIST612 - 213 nm** | | | | | | | | | | | | | | |
| LEU54_78-13.5 | 3.454 | 0.012 | 0.00 | 0.156 | 0.011 | 0.0035 | 0.0001 | 0.4315 | 14 | 1 | 22 | 1 | 147 | 10 |
| LEU54_78-3.2 | 2.277 | 0.008 | 0.00 | 0.162 | 0.009 | 0.0034 | 0.0001 | 0.4376 | 14 | 1 | 22 | 1 | 153 | 8 |
| LEU54_78-13.1 | 5.488 | 0.023 | 0.00 | 0.256 | 0.010 | 0.0041 | 0.0001 | 0.4761 | 13 | 1 | 26 | 0 | 231 | 8 |
| LEU54_78-3.1 | 3.679 | 0.017 | 0.00 | 0.319 | 0.012 | 0.0045 | 0.0001 | 0.4925 | 12 | 1 | 29 | 1 | 281 | 10 |

Continuation of Table A.7

| Sample/ Spot | U (ppm) | $^{206}Pb$ (ppm) | Th/U | $^{207}Pb/^{235}U$ | 1σ | $^{206}Pb/^{238}U$ | 1σ | Err. correl. | Model age (Ma) | 1σ | $^{207}Pb/^{235}U$ Age (Ma) | 1σ | $^{206}Pb/^{238}U$ | 1σ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEU54_78-3.9 | 2.135 | 0.012 | 0.00 | 0.370 | 0.018 | 0.0055 | 0.0001 | 0.4871 | 16 | 1 | 36 | 1 | 320 | 13 |
| LEU54_78-3.8 | 3.228 | 0.018 | 0.00 | 0.408 | 0.013 | 0.0056 | 0.0001 | 0.4992 | 14 | 1 | 36 | 1 | 347 | 9 |
| LEU54_78-13.2 | 2.459 | 0.015 | 0.00 | 0.439 | 0.021 | 0.0060 | 0.0001 | 0.4984 | 15 | 1 | 39 | 1 | 370 | 15 |
| LEU54_78-3.7 | 2.384 | 0.016 | 0.00 | 0.543 | 0.019 | 0.0065 | 0.0001 | 0.5165 | 12 | 1 | 42 | 1 | 441 | 13 |
| LEU54_78-13.4 | 4.114 | 0.029 | 0.00 | 0.548 | 0.016 | 0.0071 | 0.0001 | 0.5083 | 15 | 1 | 45 | 1 | 443 | 10 |
| LEU54_78-13.3 | 5.076 | 0.037 | 0.00 | 0.586 | 0.015 | 0.0073 | 0.0001 | 0.5135 | 15 | 1 | 47 | 1 | 468 | 9 |
| LEU54_78-3.3 | 3.176 | 0.035 | 0.00 | 1.023 | 0.024 | 0.0109 | 0.0001 | 0.5362 | 13 | 1 | 70 | 1 | 716 | 12 |
| LEU54_78-13.12 | 0.449 | 0.007 | 0.00 | 1.510 | 0.118 | 0.0147 | 0.0006 | 0.5500 | 10 | 6 | 94 | 4 | 935 | 47 |
| | | | | | | | | | | | | | | |
| **SIB241.60** | | | | | | | | | | | | | | |
| **NIST612 - 213 nm** | | | | | | | | | | | | | | |
| SIB241-9 | 3.161 | 0.010 | 0.01 | 0.075655 | 0.008 | 0.0031 | 0.0001 | 0.3465 | 17 | 1 | 20 | 1 | 74 | 7 |
| SIB241-10 | 3.743 | 0.012 | 0.01 | 0.083846 | 0.007 | 0.0032 | 0.0001 | 0.3579 | 17 | 1 | 20 | 1 | 82 | 7 |
| SIB241-10.4 | 3.845 | 0.012 | 0.02 | 0.08878 | 0.005 | 0.0032 | 0.0001 | 0.3639 | 16 | 0 | 21 | 0 | 86 | 5 |
| SIB241-10.6 | 5.976 | 0.019 | 0.01 | 0.092028 | 0.004 | 0.0032 | 0.0000 | 0.3675 | 17 | 0 | 21 | 0 | 89 | 3 |
| SIB241-10.5.3 | 4.342 | 0.020 | 0.02 | 0.216338 | 0.008 | 0.0046 | 0.0001 | 0.4384 | 18 | 1 | 29 | 0 | 199 | 7 |
| SIB241-10.5.2 | 1.474 | 0.008 | 0.02 | 0.252873 | 0.013 | 0.0053 | 0.0001 | 0.4399 | 21 | 1 | 34 | 1 | 229 | 11 |
| SIB241-10.5.4 | 0.867 | 0.005 | 0.04 | 0.305951 | 0.021 | 0.0061 | 0.0002 | 0.4477 | 23 | 1 | 39 | 1 | 271 | 16 |
| SIB241-8 | 1.022 | 0.006 | 0.03 | 0.443213 | 0.03 | 0.0063 | 0.0002 | 0.4929 | 16 | 2 | 40 | 1 | 373 | 21 |
| SIB241-10.3 | 0.832 | 0.005 | 0.03 | 0.401069 | 0.028 | 0.0065 | 0.0002 | 0.4759 | 20 | 2 | 42 | 1 | 342 | 20 |
| SIB241-6 | 0.496 | 0.003 | 0.03 | 0.439921 | 0.045 | 0.0067 | 0.0003 | 0.4833 | 20 | 3 | 43 | 2 | 370 | 31 |
| SIB241-2 | 0.548 | 0.005 | 0.09 | 0.605894 | 0.058 | 0.0088 | 0.0004 | 0.4918 | 24 | 3 | 56 | 3 | 481 | 36 |
| SIB241-10.5 | 0.984 | 0.013 | 0.04 | 1.023652 | 0.042 | 0.0130 | 0.0003 | 0.5137 | 28 | 2 | 83 | 2 | 716 | 21 |
| SIB241-5 | 0.415 | 0.007 | 0.04 | 1.332638 | 0.164 | 0.0170 | 0.0011 | 0.5165 | 36 | 9 | 109 | 7 | 860 | 70 |
| SIB241-10.2 | 0.523 | 0.010 | 0.03 | 1.66538 | 0.068 | 0.0198 | 0.0004 | 0.5289 | 36 | 4 | 126 | 3 | 995 | 26 |
| SIB241-3 | 0.595 | 0.017 | 0.16 | 2.691173 | 0.115 | 0.0287 | 0.0007 | 0.5491 | 36 | 6 | 183 | 4 | 1326 | 31 |

Continuation of Table A.7

| Sample/ Spot | U (ppm) | $^{206}Pb$ (ppm) | Th/U | $^{207}Pb/^{235}U$ | 1σ | $^{206}Pb/^{238}U$ | 1σ | Err. correl. | Model age (Ma) | 1σ | $^{207}Pb/^{235}U$ Age (Ma) | 1σ | $^{206}Pb/^{238}U$ | 1σ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SIB630.02** | | | | | | | | | | | | | | |
| **NIST612 - 213 nm** | | | | | | | | | | | | | | |
| SIB630-11 | 22.82 | 1.168 | 0.80 | 5.342254 | 0.021 | 0.0512 | 0.0001 | 0.6008 | 31 | 1 | 322 | 1 | 1876 | 3 |
| SIB630-13 | 43.45 | 2.329 | 0.59 | 5.551641 | 0.031 | 0.0536 | 0.0002 | 0.5952 | 35 | 1 | 337 | 1 | 1909 | 5 |
| SIB630-5.3 | 6.71 | 0.423 | 0.05 | 6.563168 | 0.062 | 0.0630 | 0.0004 | 0.5998 | 38 | 3 | 394 | 2 | 2054 | 8 |
| SIB630-15 | 14.67 | 1.216 | 0.50 | 8.603445 | 0.057 | 0.0829 | 0.0003 | 0.6182 | 53 | 3 | 514 | 2 | 2297 | 6 |
| SIB630-12 | 17.56 | 1.467 | 0.17 | 8.859905 | 0.054 | 0.0835 | 0.0003 | 0.6201 | 41 | 2 | 517 | 2 | 2324 | 6 |
| SIB630-5 | 19.36 | 1.688 | 0.02 | 9.128006 | 0.042 | 0.0872 | 0.0003 | 0.6269 | 51 | 2 | 539 | 2 | 2351 | 4 |
| SIB630-5.2 | 22.60 | 2.143 | 0.02 | 9.922489 | 0.041 | 0.0948 | 0.0002 | 0.6318 | 55 | 2 | 584 | 1 | 2428 | 4 |
| SIB630-14.2 | 20.34 | 2.210 | 0.12 | 11.74599 | 0.07 | 0.1086 | 0.0004 | 0.6408 | 41 | 3 | 665 | 2 | 2584 | 6 |
| SIB630-15.2 | 2.33 | 0.679 | 0.55 | 31.69403 | 0.289 | 0.2918 | 0.0019 | 0.7323 | 101 | 12 | 1651 | 10 | 3541 | 9 |
| SIB630-14 | 11.15 | 3.297 | 0.26 | 32.04601 | 0.101 | 0.2957 | 0.0007 | 0.7298 | 107 | 4 | 1670 | 3 | 3552 | 3 |
| SIB630-11.2 | 2.91 | 1.049 | 0.54 | 38.00044 | 0.198 | 0.3608 | 0.0014 | 0.7502 | 194 | 8 | 1986 | 7 | 3720 | 5 |
| SIB630-13.2 | 6.47 | 2.439 | 0.56 | 40.00204 | 0.195 | 0.3771 | 0.0014 | 0.7562 | 186 | 7 | 2063 | 6 | 3771 | 5 |
| SIB630-12.2 | 3.84 | 1.639 | 0.35 | 46.12041 | 0.272 | 0.4272 | 0.0019 | 0.7712 | 164 | 10 | 2293 | 9 | 3912 | 6 |
| **SIB1023.62** | | | | | | | | | | | | | | |
| **NIST612 - 213 nm** | | | | | | | | | | | | | | |
| SIB1023-3.4 | 26.48 | 0.112 | 0.02 | 0.342512 | 0.004 | 0.0042 | 0.0000 | 0.5110 | 8 | 0 | 27 | 0 | 299 | 3 |
| SIB1023-7.6 | 23.55 | 0.117 | 0.02 | 0.425782 | 0.006 | 0.0050 | 0.0000 | 0.5190 | 9 | 0 | 32 | 0 | 360 | 4 |
| SIB1023-7.1 | 10.82 | 0.079 | 0.03 | 0.690189 | 0.012 | 0.0073 | 0.0001 | 0.5320 | 8 | 1 | 47 | 0 | 533 | 7 |
| SIB1023-7.5 | 11.61 | 0.102 | 0.02 | 0.853614 | 0.011 | 0.0088 | 0.0001 | 0.5376 | 9 | 1 | 57 | 0 | 627 | 6 |
| SIB1023-3.1 | 16.51 | 0.183 | 0.02 | 1.100802 | 0.014 | 0.0111 | 0.0001 | 0.5424 | 10 | 1 | 71 | 0 | 754 | 7 |
| SIB1023-7.3 | 6.36 | 0.077 | 0.03 | 1.255945 | 0.022 | 0.0121 | 0.0001 | 0.5470 | 8 | 1 | 78 | 1 | 826 | 10 |
| SIB1023-3.2 | 9.38 | 0.129 | 0.03 | 1.422853 | 0.028 | 0.0137 | 0.0001 | 0.5483 | 9 | 1 | 88 | 1 | 899 | 12 |
| SIB1023-7.2 | 5.19 | 0.087 | 0.07 | 1.772464 | 0.027 | 0.0168 | 0.0001 | 0.5538 | 9 | 1 | 108 | 1 | 1035 | 10 |
| SIB1023-7.9 | 3.15 | 0.084 | 0.08 | 2.886046 | 0.048 | 0.0266 | 0.0003 | 0.5677 | 9 | 2 | 169 | 2 | 1378 | 13 |
| SIB1023-7.8 | 9.92 | 0.266 | 0.02 | 2.919298 | 0.025 | 0.0268 | 0.0001 | 0.5706 | 9 | 1 | 171 | 1 | 1387 | 7 |

Continuation of Table A.7

| Sample/ Spot | U (ppm) | $^{206}$Pb (ppm) | Th/U | $^{207}$Pb/$^{235}$U | 1σ | $^{206}$Pb/$^{238}$U | 1σ | Err. correl. | Model age (Ma) | 1σ | $^{207}$Pb/$^{235}$U Age (Ma) | 1σ | $^{206}$Pb/$^{238}$U | 1σ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIB1023-7.4 | 12.00 | 0.381 | 0.03 | 3.470085 | 0.025 | 0.0317 | 0.0001 | 0.5766 | 10 | 1 | 201 | 1 | 1520 | 6 |
| SIB1023-7.7 | 15.47 | 0.723 | 0.01 | 5.178799 | 0.027 | 0.0468 | 0.0001 | 0.5955 | 10 | 1 | 295 | 1 | 1849 | 4 |
| SIB1023-3.3 | 6.14 | 0.293 | 0.04 | 5.270473 | 0.044 | 0.0477 | 0.0002 | 0.5895 | 11 | 2 | 300 | 1 | 1864 | 7 |
| | | | | | | | | | | | | | | |
| **SLA1167.68** | | | | | | | | | | | | | | |
| **NIST612 - 213 nm** | | | | | | | | | | | | | | |
| SLA1167.88-17 | 3.21 | 0.013 | 0.02 | 0.211021 | 0.042 | 0.0041 | 0.0003 | 0.4072 | 16 | 3 | 27 | 2 | 194 | 34 |
| SLA1167.88-27 | 0.68 | 0.003 | 0.02 | 0.378038 | 0.073 | 0.0048 | 0.0004 | 0.4678 | 10 | 4 | 31 | 3 | 326 | 53 |
| SLA1167.88-21 | 16.43 | 0.110 | 0.00 | 0.507156 | 0.015 | 0.0067 | 0.0001 | 0.4637 | 15 | 1 | 43 | 1 | 417 | 10 |
| SLA1167.88-11 | 1.13 | 0.008 | 0.02 | 0.634542 | 0.103 | 0.0073 | 0.0006 | 0.4795 | 12 | 5 | 47 | 4 | 499 | 63 |
| SLA1167.88-19 | 24.58 | 0.204 | 0.00 | 0.674926 | 0.014 | 0.0083 | 0.0001 | 0.4743 | 16 | 1 | 53 | 1 | 524 | 9 |
| SLA1167.88-28 | 0.44 | 0.004 | 0.02 | 0.561043 | 0.189 | 0.0092 | 0.0014 | 0.4341 | 30 | 11 | 59 | 9 | 452 | 118 |
| SLA1167.88-20 | 27.53 | 0.262 | 0.00 | 0.813315 | 0.016 | 0.0095 | 0.0001 | 0.4809 | 16 | 1 | 61 | 1 | 604 | 9 |
| SLA1167.88-10 | 1.12 | 0.011 | 0.03 | 0.88036 | 0.096 | 0.0102 | 0.0005 | 0.4805 | 17 | 5 | 65 | 3 | 641 | 51 |
| SLA1167.88-14 | 23.34 | 0.267 | 0.00 | 1.048773 | 0.019 | 0.0115 | 0.0001 | 0.4900 | 16 | 1 | 73 | 1 | 728 | 9 |
| SLA1167.88-9 | 1.67 | 0.020 | 0.04 | 1.034136 | 0.133 | 0.0123 | 0.0008 | 0.4781 | 22 | 7 | 79 | 5 | 721 | 65 |
| SLA1167.88-26 | 0.69 | 0.009 | 0.03 | 1.236749 | 0.14 | 0.0123 | 0.0007 | 0.5013 | 10 | 7 | 79 | 4 | 817 | 62 |
| SLA1167.88-22 | 1.93 | 0.028 | 0.02 | 1.366415 | 0.08 | 0.0143 | 0.0004 | 0.4958 | 16 | 4 | 92 | 3 | 875 | 34 |
| SLA1167.88-24 | 8.46 | 0.134 | 0.01 | 1.524356 | 0.037 | 0.0159 | 0.0002 | 0.4983 | 17 | 2 | 102 | 1 | 940 | 15 |
| SLA1167.88-1 | 1.41 | 0.028 | 0.02 | 2.01848 | 0.121 | 0.0198 | 0.0006 | 0.5060 | 15 | 6 | 127 | 4 | 1122 | 40 |
| SLA1167.88-23 | 1.38 | 0.028 | 0.02 | 1.817404 | 0.12 | 0.0203 | 0.0007 | 0.4903 | 30 | 6 | 129 | 4 | 1052 | 43 |
| SLA1167.88-4 | 10.76 | 0.256 | 0.00 | 2.389494 | 0.061 | 0.0238 | 0.0003 | 0.5062 | 20 | 3 | 152 | 2 | 1239 | 18 |
| SLA1167.88-15 | 30.01 | 0.749 | 0.00 | 2.534718 | 0.027 | 0.0249 | 0.0001 | 0.5106 | 19 | 1 | 159 | 1 | 1282 | 8 |
| SLA1167.88-13 | 15.49 | 0.425 | 0.00 | 2.81209 | 0.042 | 0.0274 | 0.0002 | 0.5116 | 19 | 2 | 174 | 1 | 1359 | 11 |
| SLA1167.88-25 | 3.26 | 0.101 | 0.02 | 3.28592 | 0.113 | 0.0309 | 0.0005 | 0.5163 | 15 | 6 | 196 | 3 | 1478 | 27 |
| SLA1167.88-7 | 16.66 | 0.548 | 0.00 | 3.426384 | 0.041 | 0.0329 | 0.0002 | 0.5174 | 20 | 2 | 209 | 1 | 1510 | 9 |
| SLA1167.88-12 | 2.08 | 0.075 | 0.01 | 3.666293 | 0.235 | 0.0359 | 0.0012 | 0.5119 | 26 | 12 | 227 | 7 | 1564 | 50 |
| SLA1167.88-8 | 5.35 | 0.203 | 0.02 | 3.898581 | 0.098 | 0.0379 | 0.0005 | 0.5145 | 26 | 5 | 240 | 3 | 1613 | 20 |

Continuation of Table A.7

| Sample/ Spot | U (ppm) | $^{206}Pb$ (ppm) | Th/U | $^{207}Pb/^{235}U$ | 1σ | $^{206}Pb/^{238}U$ | 1σ | Err. correl. | Model age (Ma) | 1σ | $^{207}Pb/^{235}U$ Age (Ma) | 1σ | $^{206}Pb/^{238}U$ | 1σ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SLA1167.88-6 | 4.03 | 0.163 | 0.02 | 4.237806 | 0.104 | 0.0403 | 0.0005 | 0.5187 | 22 | 5 | 255 | 3 | 1681 | 20 |
| SLA1167.88-18 | 4.80 | 0.234 | 0.01 | 5.069222 | 0.124 | 0.0487 | 0.0006 | 0.5202 | 30 | 6 | 307 | 4 | 1831 | 21 |
| SLA1167.88-16 | 6.13 | 0.645 | 0.01 | 11.14024 | 0.178 | 0.1053 | 0.0009 | 0.5422 | 54 | 9 | 646 | 5 | 2535 | 15 |

## A8

As a consistency test for the favoured scenario in which saline brine in the Muschelkalk dolostones mixes with a dilute fluid ascending from the basement, a simple thermodynamic model has been constructed using the software *PhreeqC* [62]. The brine (composition defined in Table A.8) was assumed to be in equilibrium with dolomite and anhydrite at 50 °C, whereas the dilute fluid (composition of a recent groundwater from the crystalline basement in Wittwer [61]; Table A.8) was assumed to be in equilibrium with calcite but undersaturated with respect to anhydrite at 65 °C.

The results show that mixing will spontaneously result in dissolution of anhydrite (saturation index, *S.I.* < 0 in Fig. A.8) and precipitation of secondary calcite and dolomite (*S.I.* > 0 in Fig. A.8) over a wide range of volumetric mixing ratios (supersaturation of dolomite is mainly caused by the large contrast in the calcium and magnesium concentrations of the endmembers). The model is therefore broadly consistent with the observations. However, as both carbonate minerals are supersaturated in this model, it is not clear why calcite precipitates alone in the shallow wells, whereas dolomite precipitates alone in the deep wells. Quartz and kaolinite precipitation on the other hand is probably triggered by cooling of the silica- and alumina-bearing basement water upon its ascent or upon mixing with the colder brine in the dolostones.

Table A.8: Chemical data on evaporative brine [57] and basement water from the Weiach well [61].

| **Parameter** | **Brine** | **Basement water** |
|---|---|---|
| pH | 6.6 | 7.66 |
| Temperature (°C) | 50 | 65 |
| Pressure (MPa) | 12 | 19 |
| $Na^+$ (mg/L) | 82120 | 2205 |
| $K^+$ (mg/L) | 4240 | 70.4 |
| $Mg^{2+}$ (mg/L) | 10000 | 0.1 |
| $Ca^{2+}$ (mg/L) | 11250 | 152 |
| $Cl^-$ (mg/L) | 176350 | 3382 |
| $SO_4^{2-}$ (mg/L) | 3920 | 431 |
| Alkalinity (mg/L) | 56 | 76 |

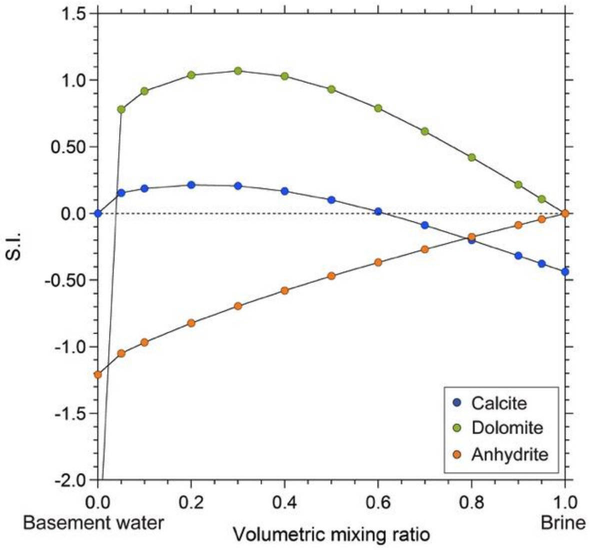


**Fig. A.8.** *Saturation indices (S.I.) of calcite, dolomite and anhydrite as a function of the volumetric mixing ratio between a hypersaline brine at 50 °C (residual Triassic dolomitizing pore water) and a recent groundwater from the crystalline basement at 65 °C, calculated using PhreeqC and data in Table A.8.*

## A9

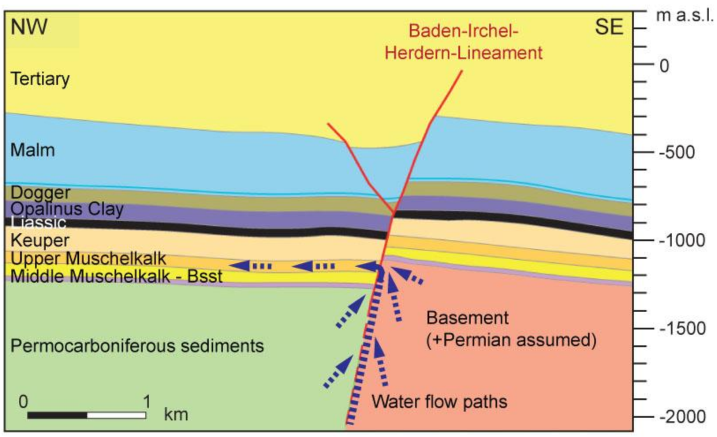


**Fig. A.9.** *Deduced infiltration of basement fluid on an interpreted NW–SE seismic transect of the Baden–Irchel–Herdern Lineament, at the margin of a Permo-carboniferous through. The fault has a throw of about 150 m, which juxtaposes the basement and the Upper Muschelkalk. Thus, ascending basement water can bypass the Middle Muschelkalk Sulfatschichten and directly infiltrate the Upper Muschelkalk (Bsst: Buntsandstein; see Fig. 1a to locate the profile; modified after Nagra, 2014).*

## References:

Nagra (2014) SGT Etappe 2: Vorschlag weiter zu untersuchender geologischer Standortgebiete mit zugehörigen Standortarealen für die Oberflächenanlage – Geologische Grundlagen Dossier II; Sedimentologische und tektonische Verhältnisse. Nagra Technischer Bericht NTB 14-02. Nagra, Wettingen, Switzerland.