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Supplemental Material

Table S1. (ST1). PHREEQC inverse mixing modeling for the Mississippian Leadville Ls brine (SOLUTION 3) assumed to be evolved from a mixture of the meteoric water endmember (SOLUTION 1) and evaporated paleo-seawater endmember (SOLUTION 2).

Table S2. (ST2). PHREEQC inverse mixing modeling for the salt anticline brine (SOLUTION 3) assumed to be evolved from a mixture of the meteoric water endmember (SOLUTION 1) and evaporated paleo-seawater endmember (SOLUTION 2).

Table S1. (ST1). PHREEQC inverse mixing modeling for the Mississippian Leadville Ls brine (SOLUTION 3) assumed to be evolved from a mixture of the meteoric water endmember (SOLUTION 1) and evaporated paleo-seawater endmember (SOLUTION 2).

```
TITLE Inverse modeling of the formation of Leadville Ls brine

SOLUTION 1 Initial1: Groundwater-Burro Canyon Fm and Navajo Ss(averaged)
    temp      19.3
    pH        7.47
    pe        4
    redox     pe
    units     mg/l
    density   1.0011
    Alkalinity 5.77 meq/l
    Br        0.5
    Ca        137.05
    Cl        54.16
    K         8.6
    Na        5.21
    S(6)      398.81
    -water    1 # kg

SOLUTION 2 Initial2: Cane Creek brine
    temp      34.8
    pH        5.18
    pe        4
    redox     pe
    units     mg/l
    density   1.27
    Alkalinity 0 meq/l
    Br        3109
    Ca        42400
    Cl        215651
    K         18488
    Na        25249
    S(6)      408
    -water    1 # kg

SOLUTION 3 Final: Mississippian Leadville Ls brine
    temp      14.2
    pH        6.78
    pe        4
    redox     pe
    units     mg/l
    density   1.05
    Alkalinity 12.28 meq/l
    Br        81.91
    Ca        3342
    Cl        40524
    K         1081
    Na        22246
    S(6)      1330
    -water    1 # kg

INVERSE_MODELING 1
    -solutions      1        2        3
```

```
    -uncertainty    0.4      0.4      0.1
    -phases
        Halite
        Calcite
        Gypsum
        Anhydrite
        Sylvite
    -balances
        Br          0.4      0.4      0.1
        Cl          0.4      0.4      0.1
        Na          0.4      0.4      0.1
        K           0.4      0.4      0.1
    -range             1000
    -tolerance         1e-10
    -mineral_water     true
END
```

Table S2. (ST2). PHREEQC inverse mixing modeling for the salt anticline brine (SOLUTION 3) assumed to be evolved from a mixture of the meteoric water endmember (SOLUTION 1) and evaporated paleo-seawater endmember (SOLUTION 2).

```
TITLE Inverse modeling of the formation of Salt Anticline Brine

SOLUTION 1 Initial1: Groundwater-Burro Canyon Fm and Navajo Ss(averaged)
    temp      19.3
    pH        7.47
    pe        4
    redox     pe
    units     mg/l
    density   1.0011
    Alkalinity 5.77 meq/l
    Br        0.5
    Ca        137.05
    Cl        54.16
    K         8.6
    Na        5.21
    S(6)      398.81
    -water    1 # kg

SOLUTION 2 Initial2: Cane Creek brine
    temp      34.8
    pH        5.18
    pe        4
    redox     pe
    units     mg/l
    density   1.27
    Alkalinity 0 meq/l
    Br        3109
    Ca        42400
    Cl        215651
    Na        25249
    S(6)      408
    K         18488
    -water    1 # kg
```

```
SOLUTION 3 Final: Salt anticline brine (averaged)
    temp      16.2
    pH        6.49
    pe        4
    redox     pe
    units     mg/l
    density   1.17
    Alkalinity 4.02 meq/l
    Br        203.35
    Ca        1452.59
    Cl        149033
    Na        87806.62
    S(6)      6779.84
    K         4049.85
    -water    1 # kg

INVERSE_MODELING 1
    -solutions      1        2        3
    -uncertainty    0.7      0.7      0.4
    -phases
        Halite            dis
        Calcite           dis
        Gypsum            dis
        Anhydrite         dis
        Sylvite           dis
    -balances
        Br          0.7      0.7      0.4
        Cl          0.7      0.7      0.4
        Na          0.7      0.7      0.4
        K           0.7      0.7      0.4
    -range             1000
    -tolerance         1e-10
    -mineral_water     true
END
```