Fluid-rock interactions of hot springs in Da Qaidam, China

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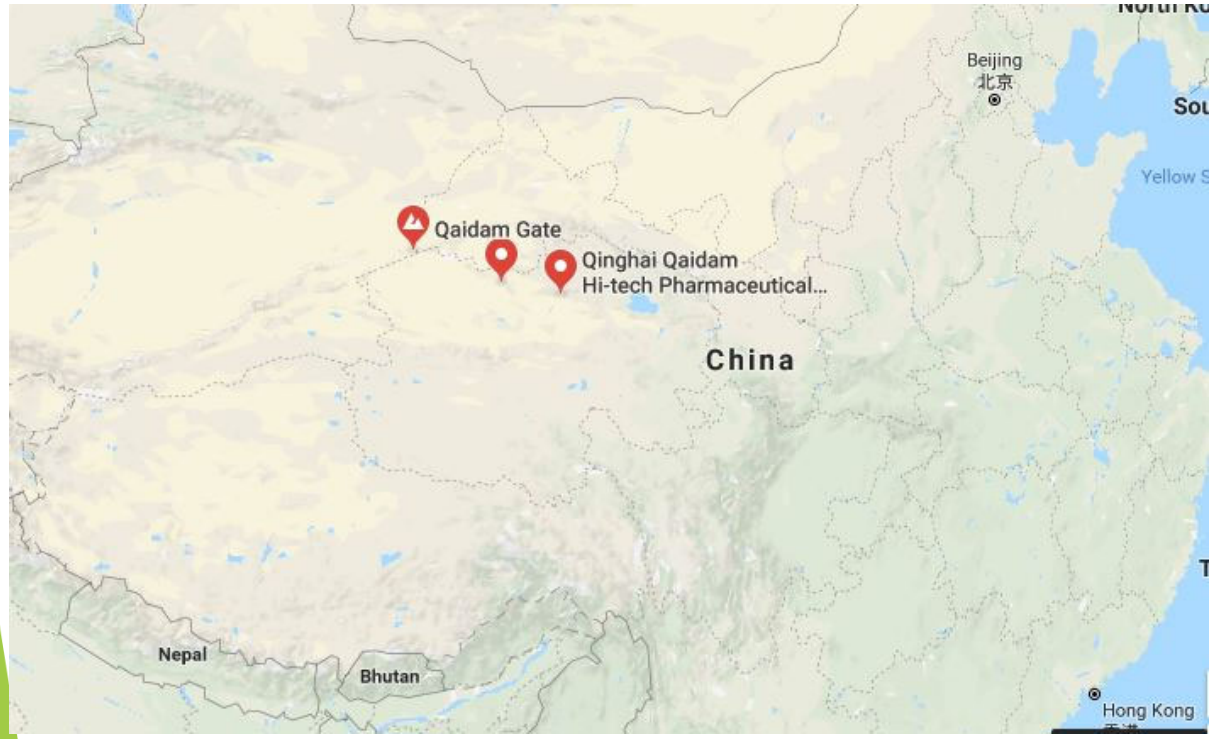
NDSU Geochemistry 2018

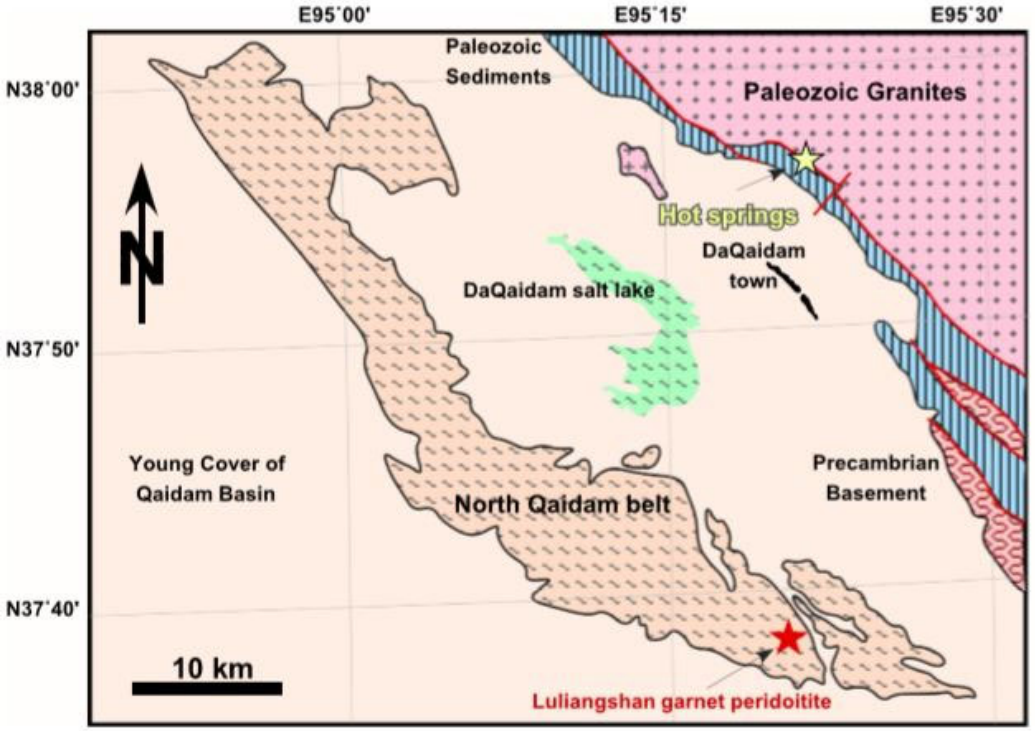
Introduction

- Central China, Northwestern portion
- Qilian Mountains
- Bathing and recreation
- Qaidam Basin
- Spring 9.5 km north of the city



Google Maps and Google Earth

Google Earth

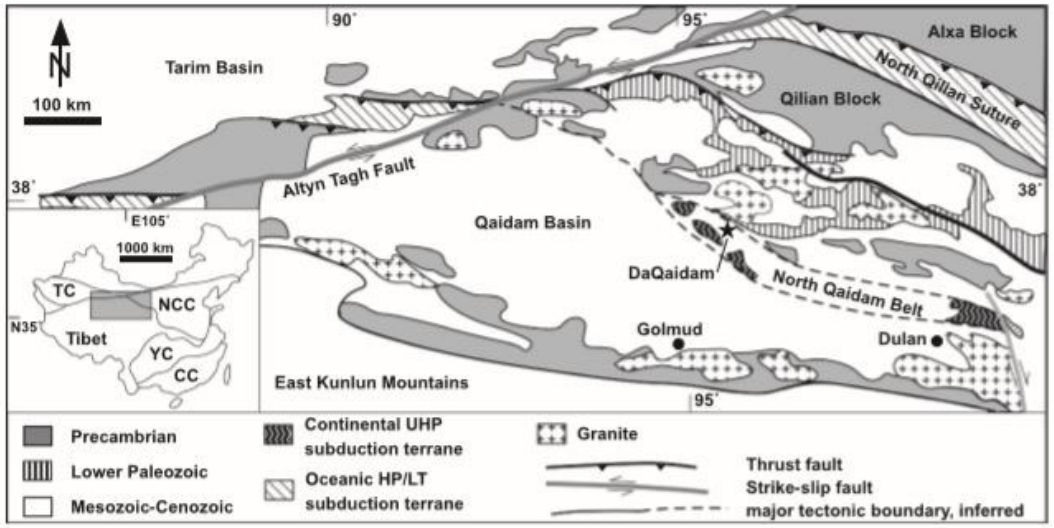


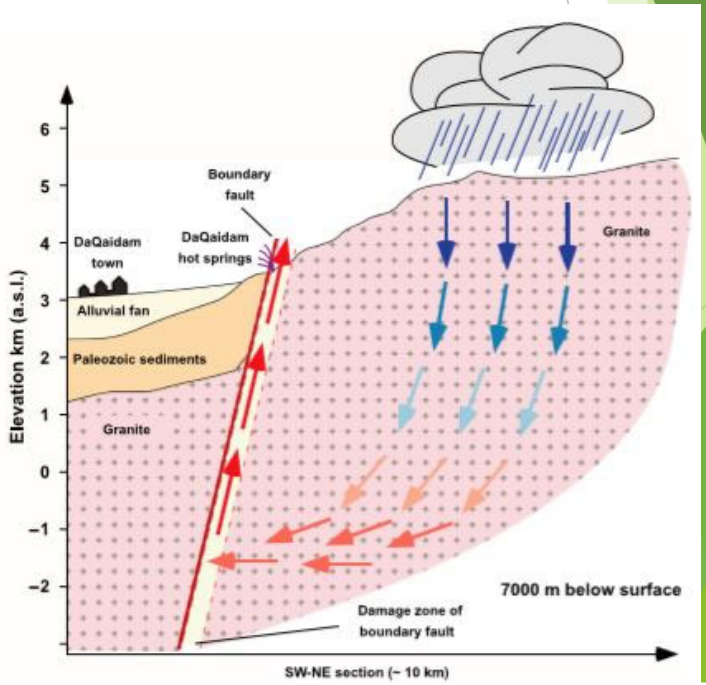
Background

- Unrelated to magma activity- rare exceptions
- Below boiling
- Surface composition = chemical + transport reactions
- Subsurface circulation
- Located at brittle upper crust
- Deep circulations along fault lines
- Solutes are a combination of older rocks and newer fractured rocks

Local Geology

- Tectonic activity
- Multiple faults
- Granite base, sediments deposited on top, topped with alluvial deposits
- Qilian Block
- Evaporative deposits- Salt flats and Gypsum deserts



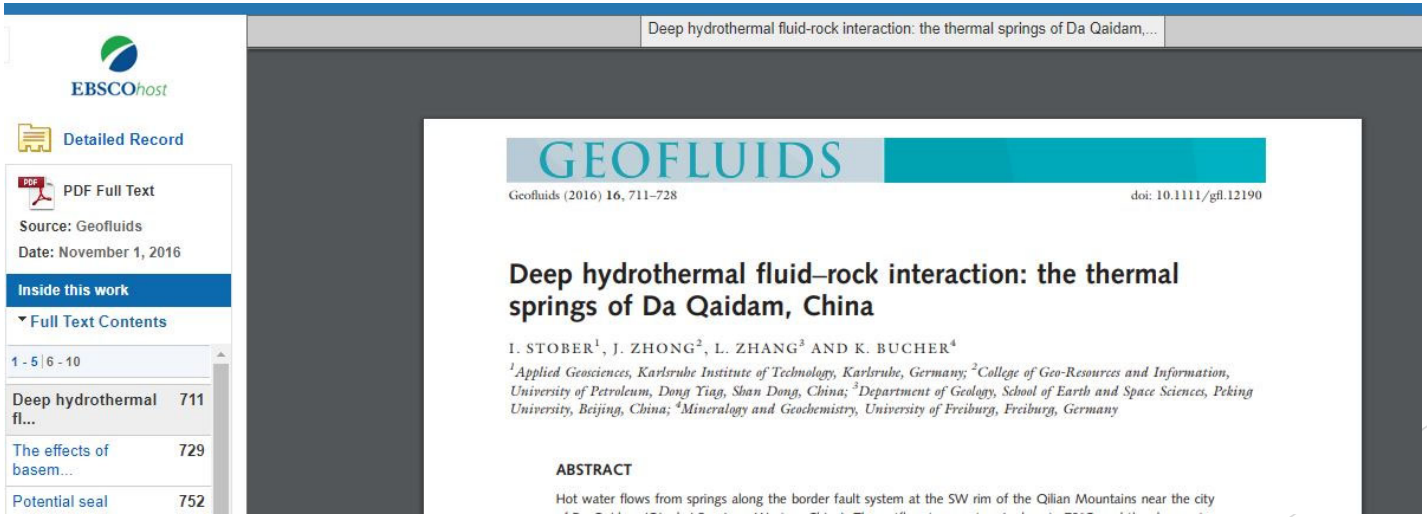


Why I chose this topic

- Fascinated by hot springs
- How they're heated
- Where they're located
- Hot thermal water mixing with cold surface water

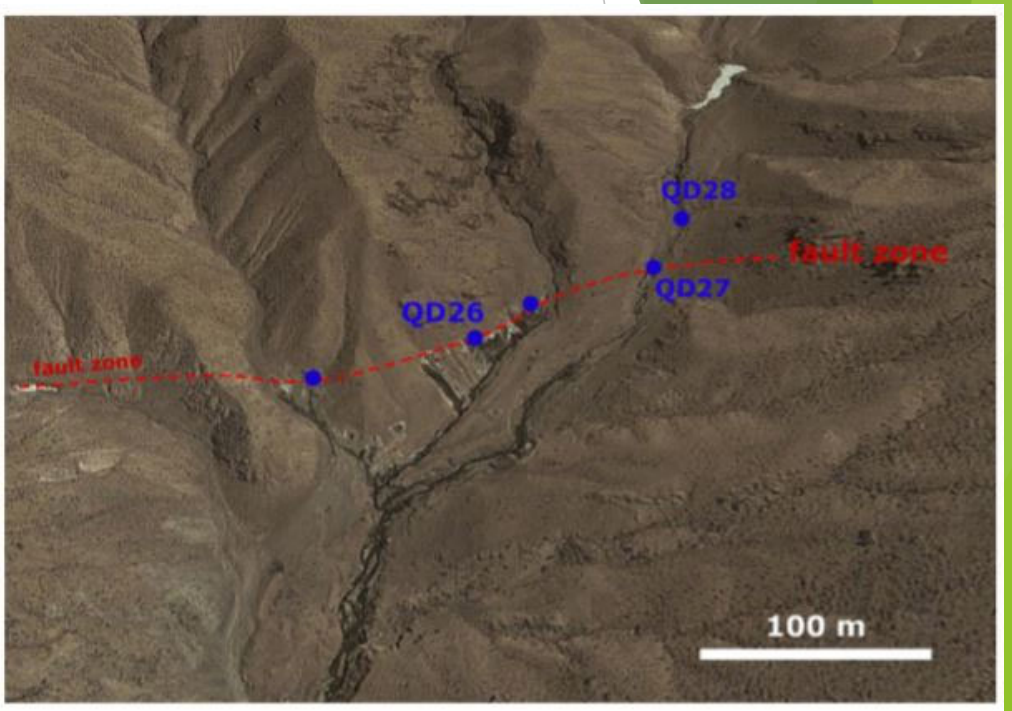
Source of data

- EBSCO
- https://web-a-ebscohost-com.ezproxy.lib.ndsu.nodak.edu/ehost/pdfviewer/pdfviewer?vid=1&sid=113459fa-e071-4080-a49e-a3b8e5ba12fc%40sdc-v-sessmgr02



Sample collection

- 2 samples directly from outflow points (QD26)
- Thermal spring bordering the brook (QD27)
- Cold water meters upstream (QD28)
- Bottles were filled completely
- Temperature, pH, and EC in the field



Previous work

- Ions: Na^{+}, Cl^{-} , SO_4^{2-},HCO_3^{-}, and $H_3BO_3^{0}$
- Dissolved: NaCl, Na_2SO_4, carbonate, and borate
- Salt components considered using SALTNORM - corresponds to the sinter they found
- PHREEQ and LLNL database used to calculate ions in solution
- Leaching experiments were done on rock samples

My work

- Changed pe values from default of 4 to 8
- What would happen if the temperature was cooled?
- Warmed?

Results

- All of the ion concentrations were the same, however the elemental values were different
- The elements became further undersaturated
- The minerals were not affected at all

pe=4 (Default)

K	-49.20	12.45	61.65	K
C	-36.95	17.73	54.68	C
C(g)	-137.53	17.73	155.26	C
Ca	-93.72	26.52	120.24	Ca
Ca(g)	-114.75	26.52	141.26	Ca
B	-73.65	20.66	94.31	B
B(g)	-151.51	20.66	172.17	B
Aragonite	1.84	3.15	1.31	CaCO3

pe=8

K	-53.20	8.45	61.65	K
C	-52.95	1.73	54.68	C
C(g)	-153.53	1.73	155.26	C
Ca	-101.72	18.52	120.24	Ca
Ca(g)	-122.75	18.52	141.26	Ca
B	-85.65	8.66	94.31	B
B(g)	-163.51	8.66	172.17	B
Aragonite	1.84	3.15	1.31	CaCO3

Results (continued)

- If the water would be cooled to room temperature (25 C)..
- A trend of precipitation occurs:

71.8 C

Borax	0.34	14.32	13.98	Na2(B4O5(OH)4):8H2O
Boric_acid	-0.22	0.09	0.31	B(OH)3

25 C

Borax	2.38	14.42	12.04	Na2(B4O5(OH)4):8H2O
Boric_acid	0.27	0.11	-0.16	B(OH)3

- However, some are not as over saturated:

Gypsum	0.21	-4.48	-4.69	CaSO4:2H2O
Gypsum	0.14	-4.39	-4.53	CaSO4:2H2O

Results (continued)

- If the hot spring would continue to heat to 80 C..
- Hotter temperatures were tried, however were not possible with the concentrations of the ions in solution
- 80 C

Borax	0.02	14.30	14.28	Na2(B4O5(OH)4):8H2O
Boric_acid	-0.29	0.08	0.37	B(OH)3
Gypsum	0.24	-4.50	-4.74	CaSO4:2H2O

71.8 C

Borax	0.34	14.32	13.98	Na2(B4O5(OH)4):8H2O
Boric_acid	-0.22	0.09	0.31	B(OH)3
Gypsum	0.21	-4.48	-4.69	CaSO4:2H2O

Conclusions

- The pe value affects the elemental's values, not any compounds
- If the hot springs cool down it could be dangerous (Heller, 2017)
- They aren't able to get much hotter
- Increased temperature continues to oversaturate solids

Questions?