GSA 2005, Salt Lake City, T118, Peña Blanca Session

Geochronology and Fluid-rock Interaction Associated with the Nopal I Uranium Deposit, Peña Blanca, Mexico

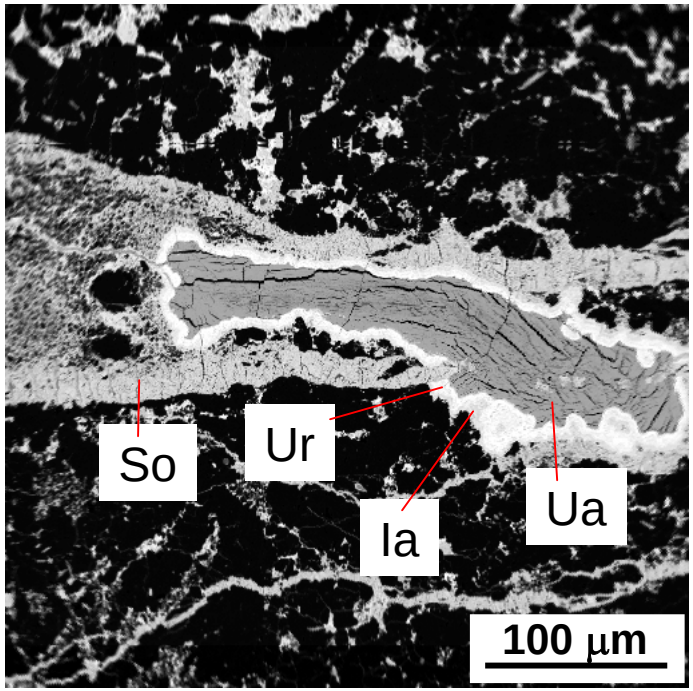
M. FAYEK[1], P.C. GOODELL[2], M. REN[2], L.R. RICIPUTI[3], A. SIMMONS[4], S. UTSUNOMIYA[5], and R.C. EWING[5]

[1]University of Tennessee, Dept. Earth Planet. Sci., Knoxville, TN 37996, USA
[2]UTEP, Dept. Geological Sciences, El Paso, TX 79968, USA
[3]Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA
[4]Los Alamos National Laboratory, Los Alamos, NM 87545, USA
[5]University of Michigan, Dept. Geological Sci., Ann Arbor, MI 48109

This presentation has been funded in whole or in part by the U.S. Department of Energy

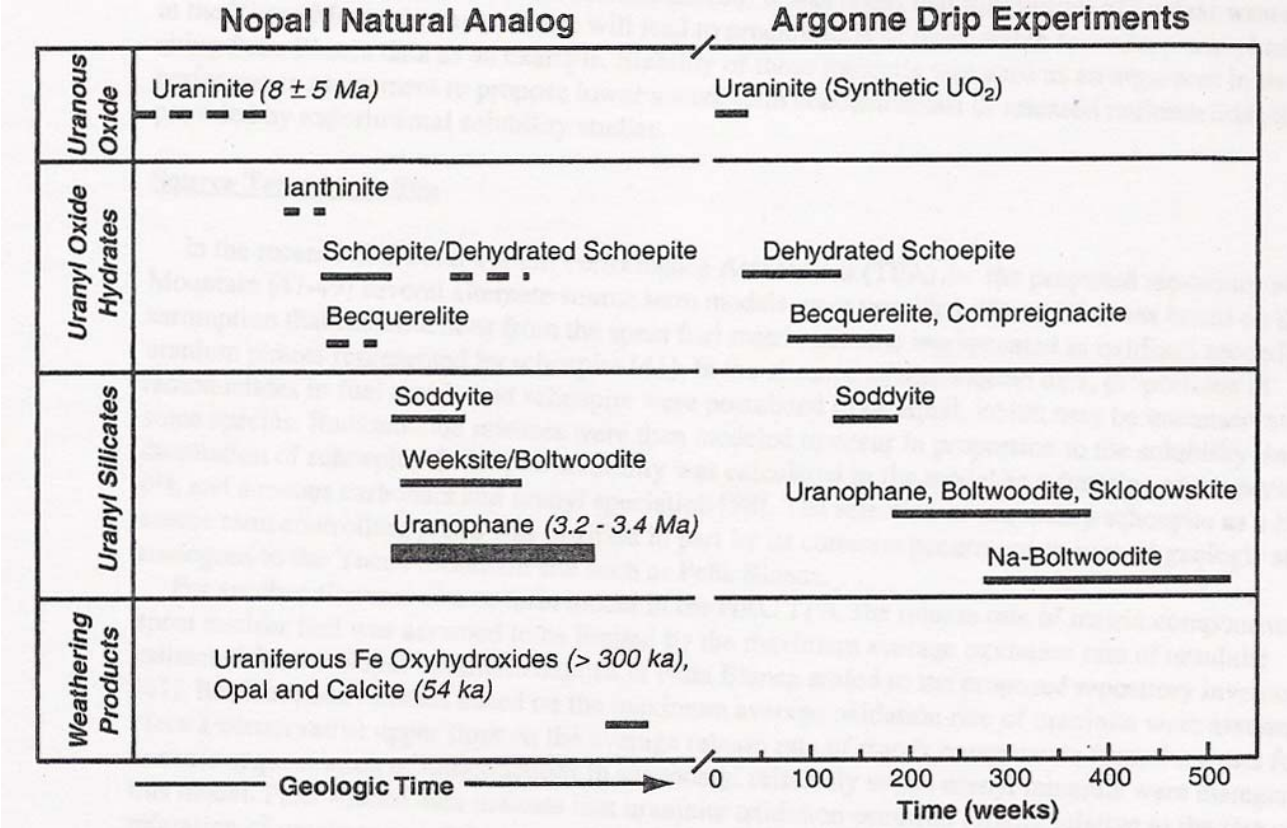
Objectives

- Establish chronology of uranium minerals
- Characterize fluids
- Relate ages to geologic/tectonic events



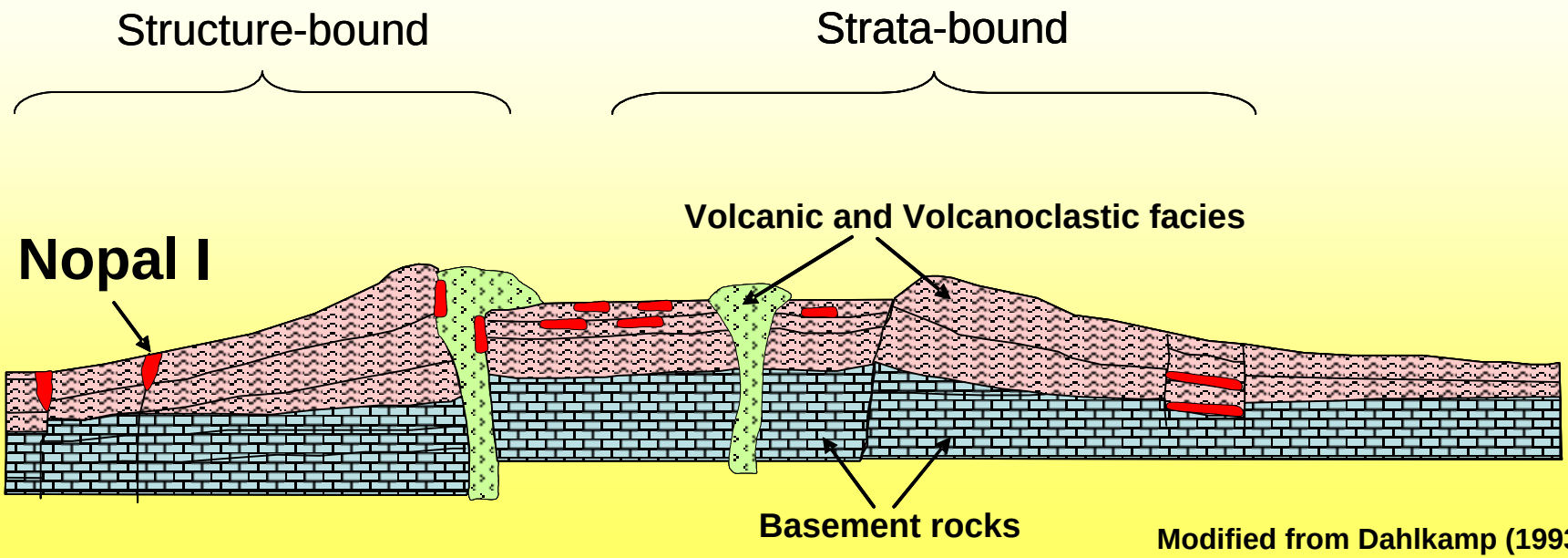
Significance

- **Realistic spent fuel corrosion rates**
- **Geologic/tectonic events**



From Murphy (2000)

Volcanic –Type Uranium Deposits



GENETIC MODELS for NOPAL I

- Volcanic vent (Pilcher, 1980) .
- Magmatic hydrothermal (Bazan,1980).
- Collapse breccia (Bell,1981).
- Deuteric and low T processes (Goodell, 1985).
- High T processes (Aniel and Leroy, 1985, George-Aniel et al. 1991).
- Intersection of fractures/faults (Reyes-Cortes, 1997).

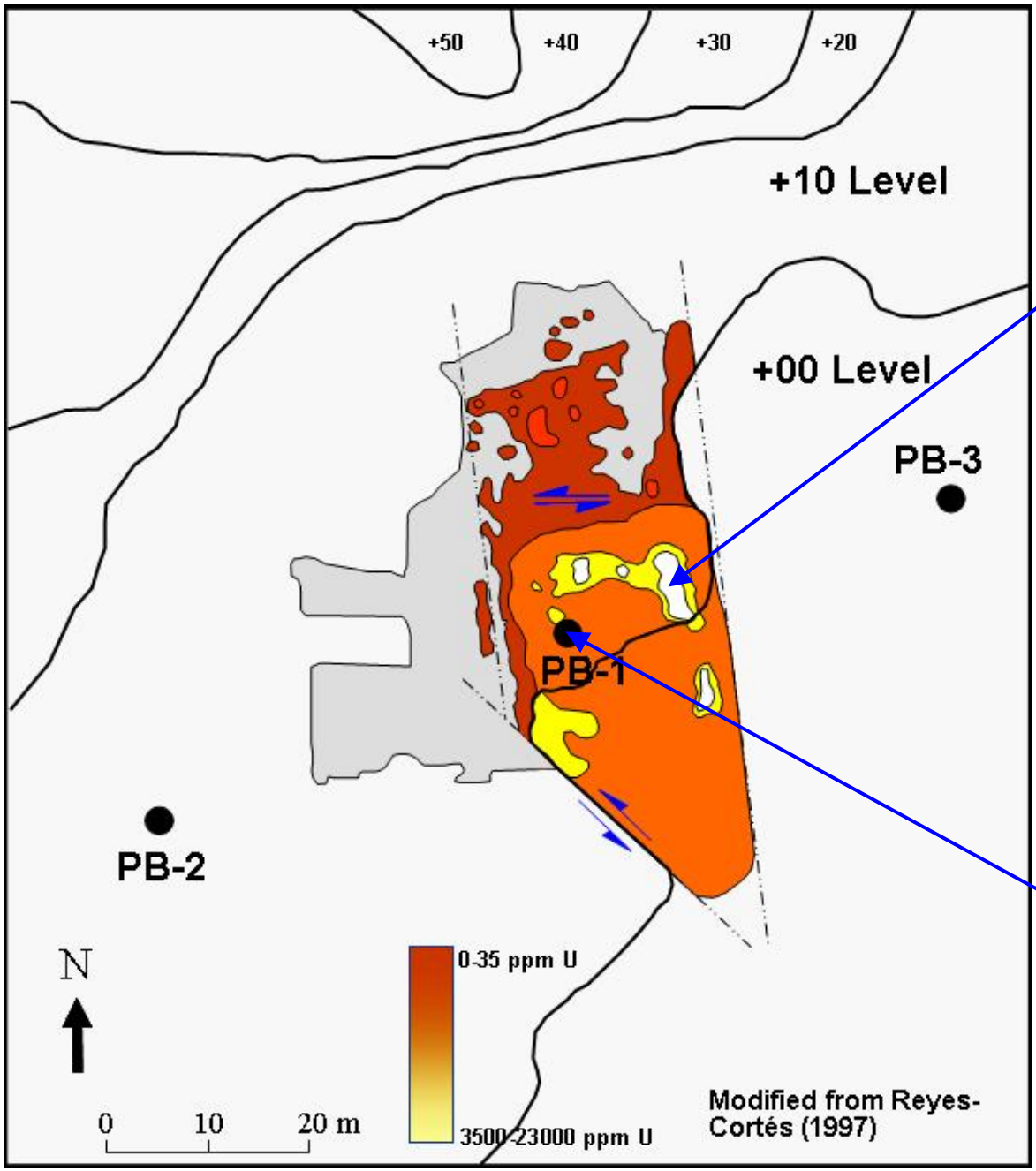
Geochronology of the Nopal I Deposit

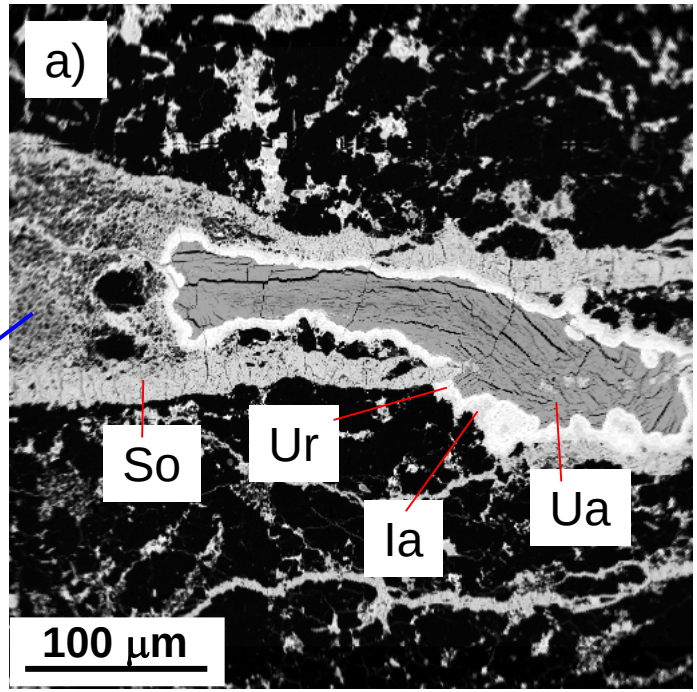
- Chemical Pb age of colloform uraninite 8±5 Ma
- Alteration of uraninite to uranyl minerals 3.2-3.4 Ma
- Uraniferous Fe-Oxyhydroxides >300 ka
- Formation of U-opals 54 ka

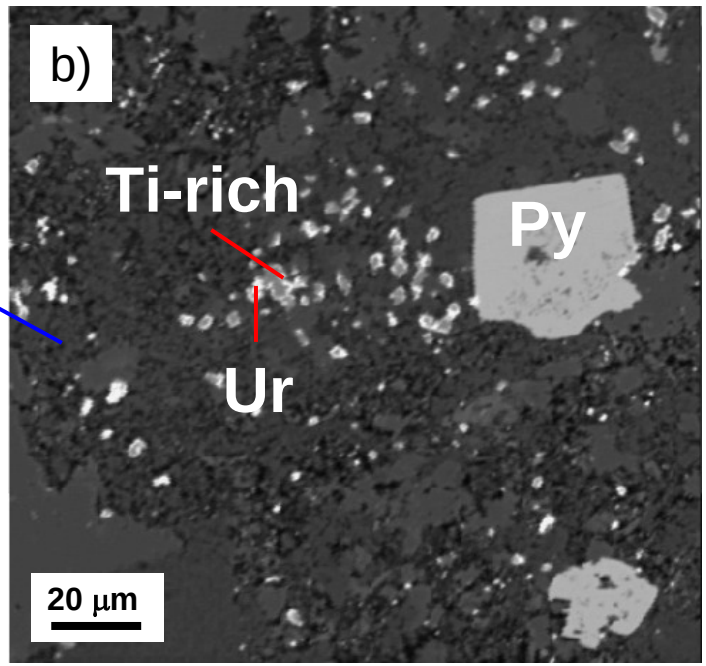
(Pearcy et al. 1994, 1995; Murphy, 2000)

REGIONAL GEOLOGY

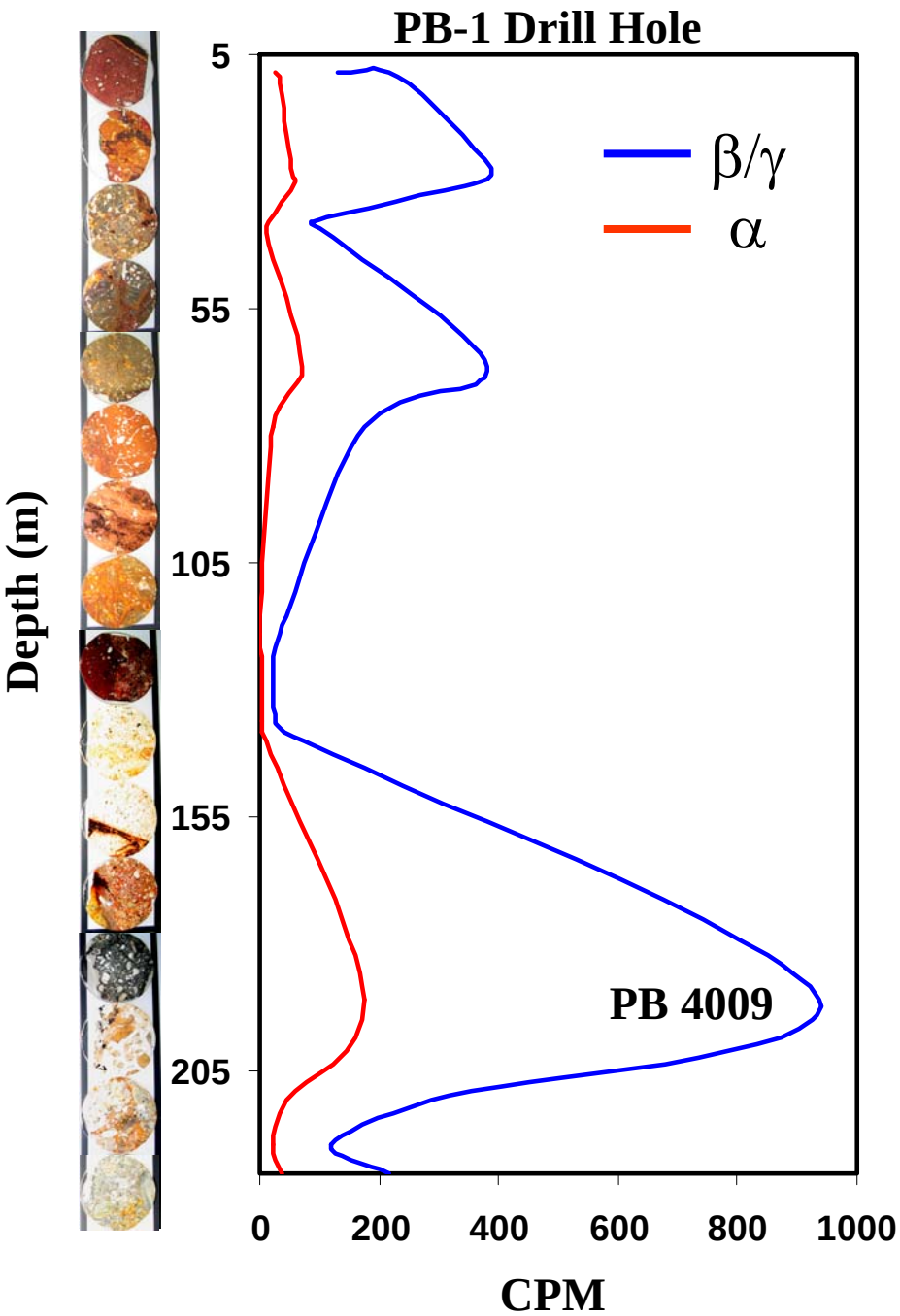
- **Laramide 90-51 Ma**
- **Basin and Range/Rio Grande Rift 35 Ma - present**

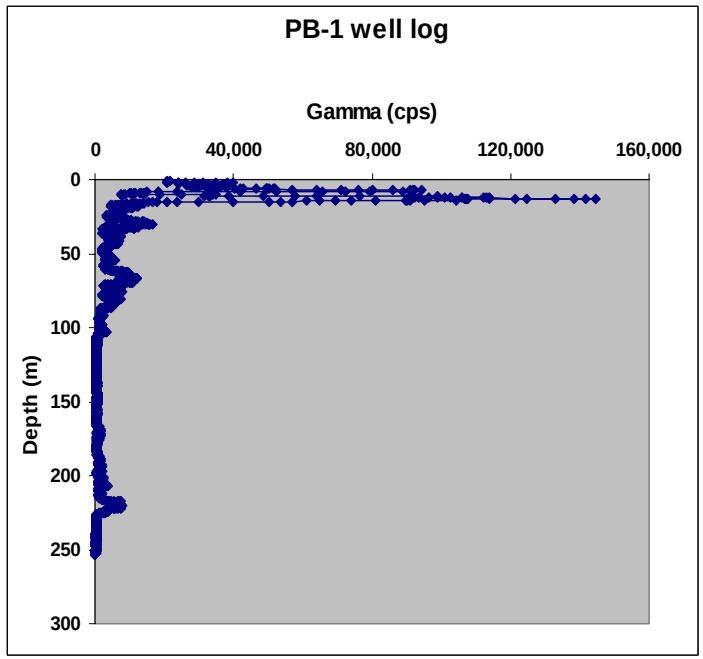

+50
+40
+30
+20
+10 Level
+00 Level
PB-3
PB-1
PB-2
N
0 10 20 m
0-35 ppm U
3500-23000 ppm U
Modified from Reyes-Cortés (1997)


a)
So
Ur
Ia
Ua
100 μm

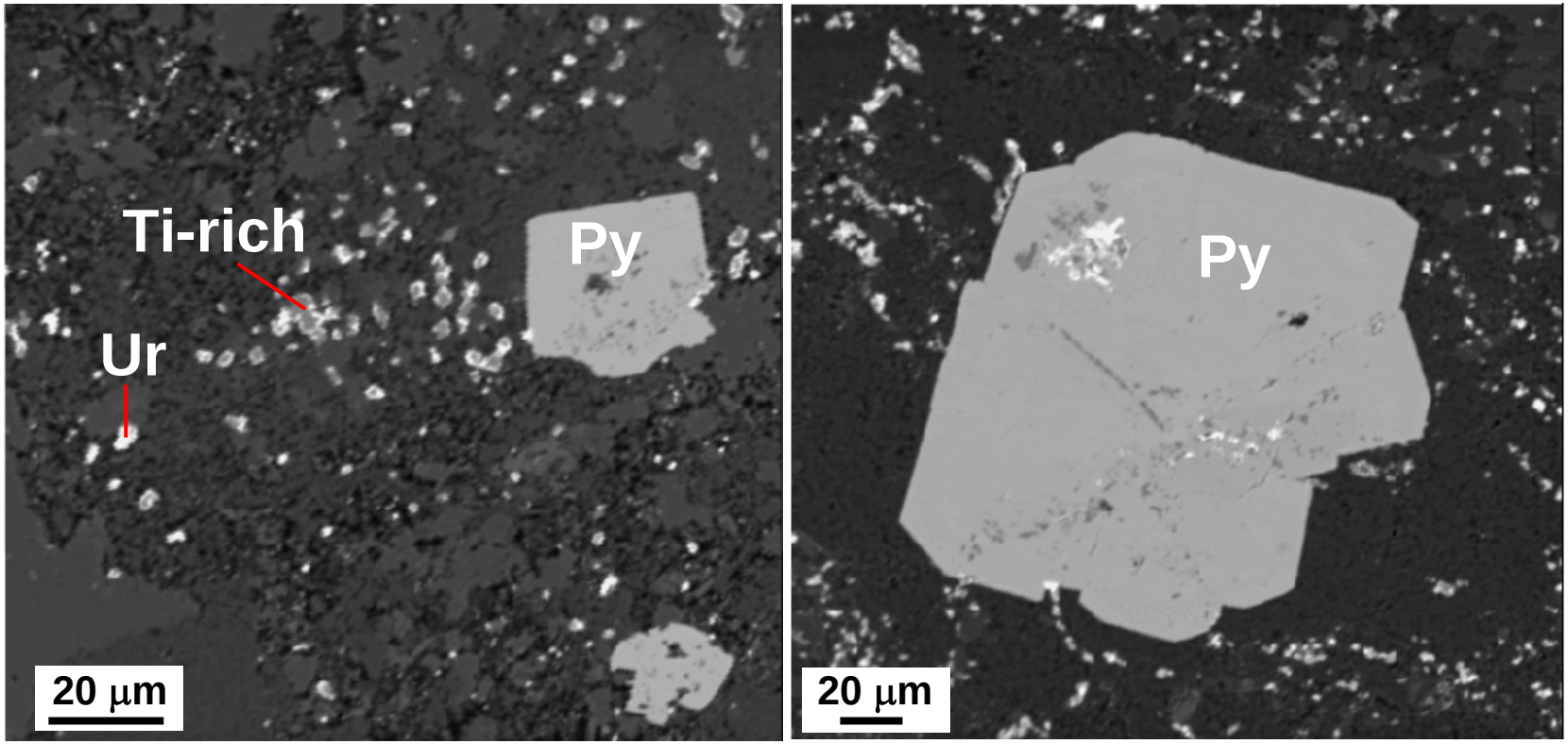

b)
Ti-rich
Py
Ur
20 μm

Results: FY04

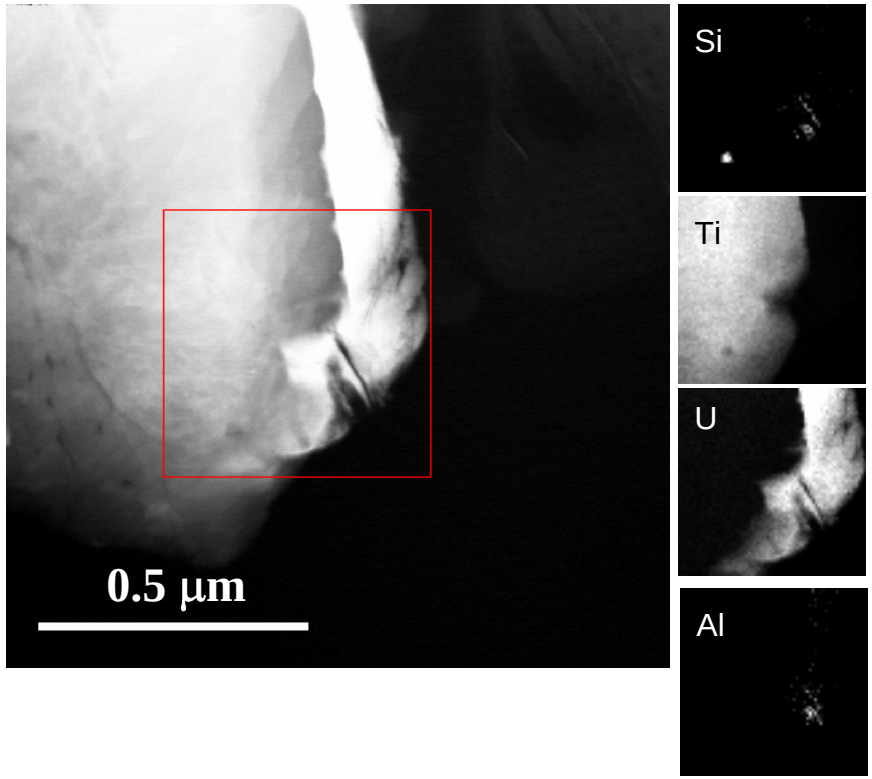


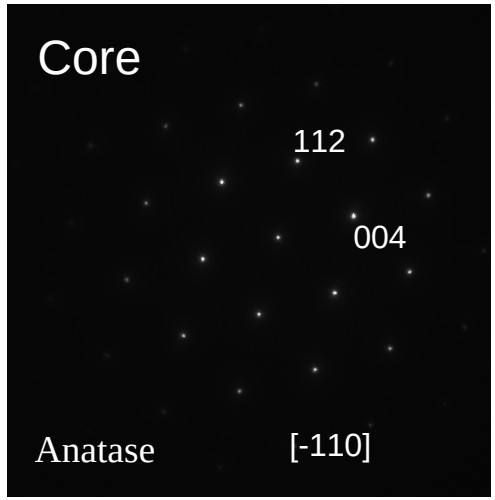


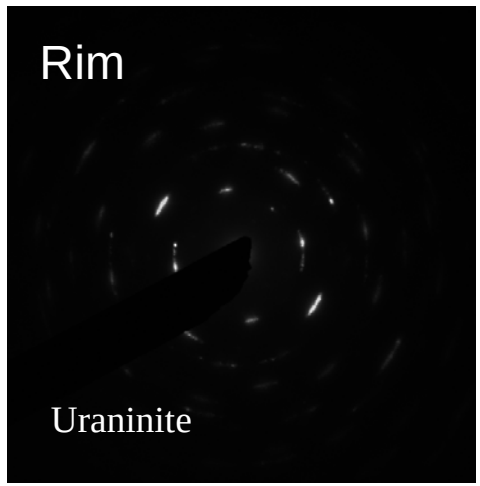
Sample PB-1 4009-Pozos



Sample PB-1 4009

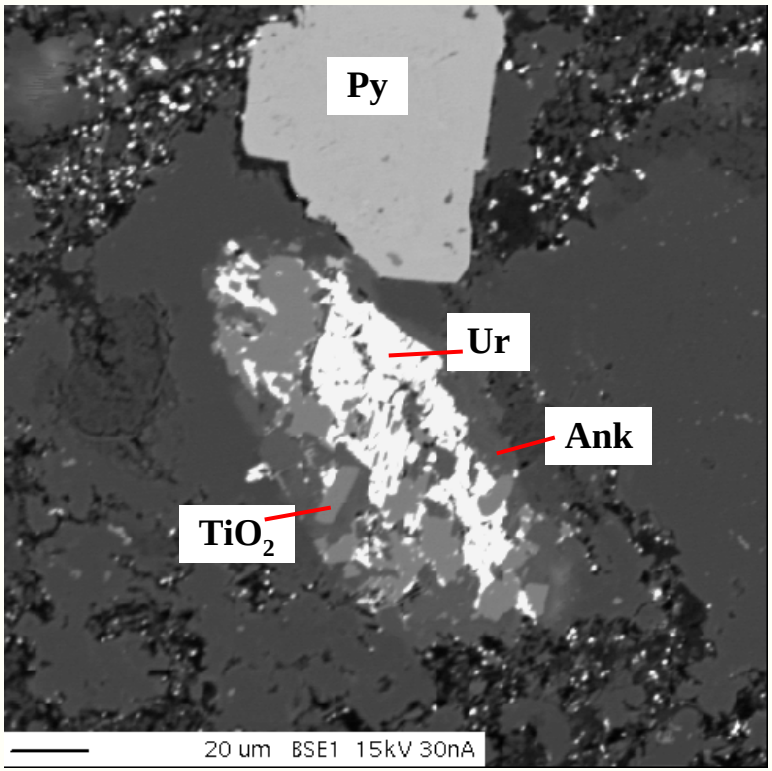




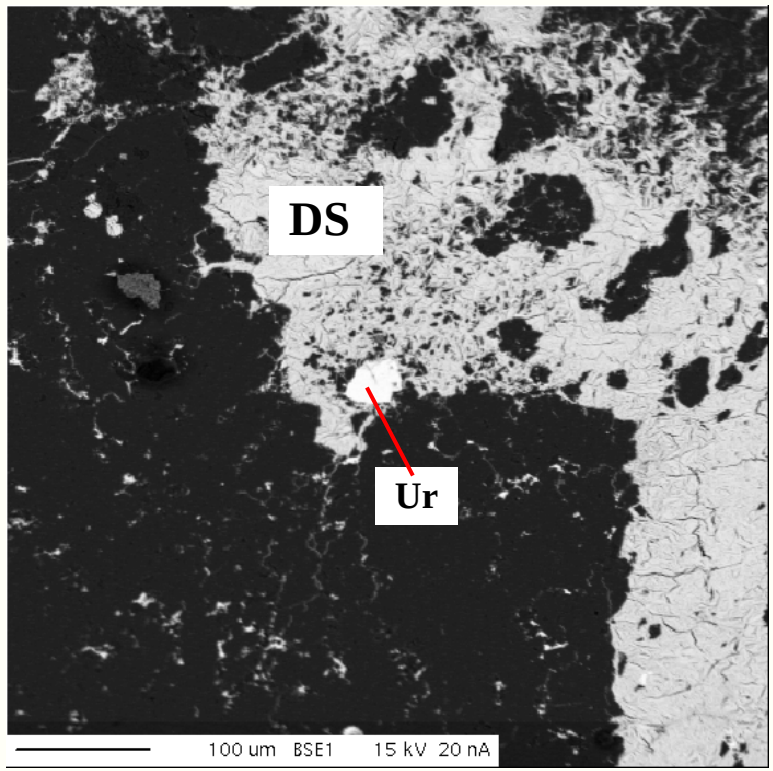


Are they related?

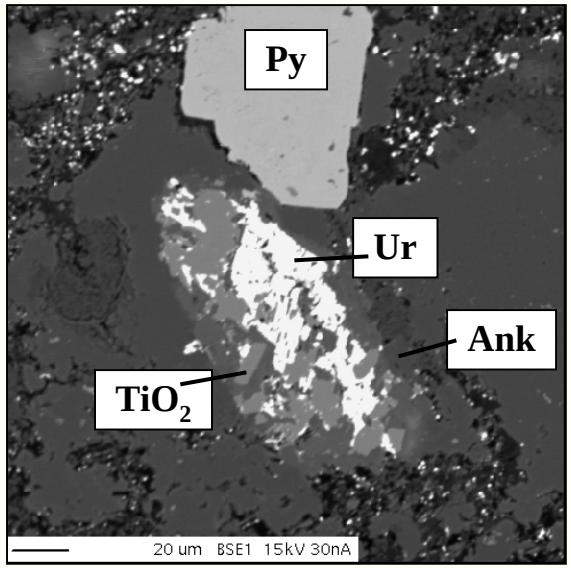
Pb-1 4009 Pozos conglomerate



Uraninite in Volcanics



Pb-1 4009 Pozos conglomerate



U-Pb age <1 Ma

$\delta^{18}O_{uran}$ = -1.5±0.9‰

$\delta^{18}O_{H2O}$ = -9.0±0.5 ‰ (meteoric)

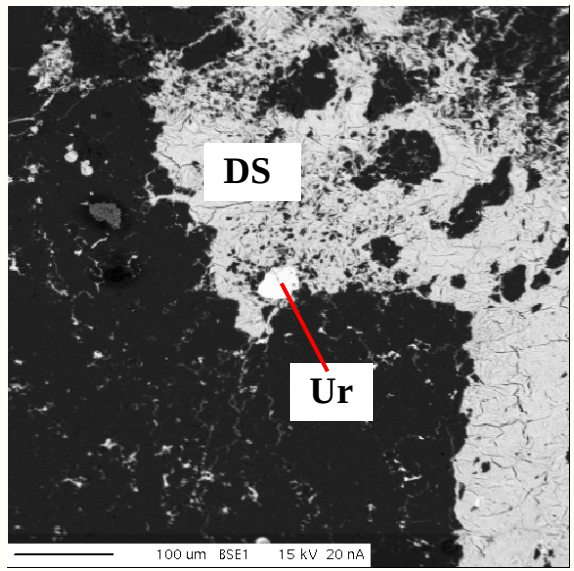
Fayek and Kyser (2000) Ur-H_2O

T = 10-20°C

Smectite T = 25-50°C (Ildefonse et al. 1990)

Measured down hole T = 28°C

Uraninite in Volcanics



U-Pb age 32±5 Ma

$\delta^{18}O_{uran}$ = -10.8 ±0.9‰

$\delta^{18}O_{H2O}$ = -9.0±0.5 ‰ (meteoric)

Fayek and Kyser (2000) Ur-H_2O

T = 45-55 °C

Kaolinite T = 60°C (Ildefonse et al. 1990)

Conclusions

- Two generations of uraninite formed from low temperature fluids consistent with Goodell (1985)
- Ages of uraninite 32±5 Ma and <1 Ma
- Early uraninite related to Basin and Range tectonics
- Future goals: (1) U-Th analyses of U^{6+} phases and opal; (2) calculate uraninite corrosion rates

Acknowledgement

U.S. DOE, Office of Civilian Radioactive Waste Management, Office of Science and Technology and International