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

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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 (Bazán, 1980).
- Collapse breccia (Bell, 1981).
- Deuteric and low T processes (Goodell, 1985).
- 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
a) Ur

So

Ua

Ur-rich

b) Ti-rich

Ur

Py

Modified from Reyes-Cortés (1997)
Results: FY04

PB-1 Drill Hole

- Blue line: β/γ counter
- Red line: α counter

PB 4009

PB-1 well log

- Gamma (cps)
- Depth (m)
Sample PB-1 4009-Pozos

Ti-rich

Ur

Py

Py
Sample PB-1 4009

Core

Anatase

[-110]

Rim

Uraninite

0.5 µm
Are they related?

Pb-1 4009 Pozos conglomerate

Uraninite in Volcanics

- **Py**
- **Ank**
- **TiO$_2$**
- **Ur**
- **DS**
**Pb-1 4009 Pozos conglomerate**

- **U-Pb age**: <1 Ma
- $\delta^{18}O_{uran} = -1.5 \pm 0.9 \permil$
- $\delta^{18}O_{H_2O} = -9.0 \pm 0.5 \permil$ (meteoric)
- Fayek and Kyser (2000) Ur-H$_2$O
- 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
- $\delta^{18}O_{uran} = -10.8 \pm 0.9 \permil$
- $\delta^{18}O_{H_2O} = -9.0 \pm 0.5 \permil$ (meteoric)
- Fayek and Kyser (2000) Ur-H$_2$O
- 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 U⁶⁺ phases and opal; (2) calculate uraninite corrosion rates

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