OCRWM Office of Science and Technology and International

DT # 45950
QA: NA
9/14/2005

MOL.20051101.0111

Stratigraphy of the PB-1 Well, Nopal I Uranium Deposit, Peña Blanca, Chihuahua, Mexico

Presented to:
Geological Society of America

Presented by:
Patrick Dobson
Earth Sciences Division
Lawrence Berkeley National
Laboratory

October 17, 2005
Salt Lake City, Utah

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

Authors and Acknowledgments

- **Other authors are:**
 - **Phil Goodell (University of Texas at El Paso)**
 - **Mostafa Fayek (University of Tennessee, Knoxville)**
 - **Felipe Melchor (PetroLab)**
 - **Mike Murrell, Ardyth Simmons, and Ron Oliver (Los Alamos National Laboratory)**
 - **Ignacio Reyes and Rodrigo de la Garza (Universidad Autónoma de Chihuahua)**
- **This work was supported by the Director, Office of Civilian Radioactive Waste Management, Office of Science and Technology and International, of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.**

Objectives

- **Stratigraphic study part of integrated research project examining migration of radionuclides at Peña Blanca**
- **Immediate objectives of study include:**
 - **Locate stratigraphic contacts in third dimension**
 - **Measure rock properties (matrix permeability, porosity, mineralogy, cation exchange capacity) of cored section**
 - **Determine fracture frequency and orientation**
- **Results of study serve as primary inputs to flow and transport models**

Previous Stratigraphic Studies

- Alba and Chavez (1974) – K-Ar dating of volcanic units
- Rodríguez et al. (1976) – Regional stratigraphy
- Calas (1977) – Geology and alteration
- Bell (1981) – Measurement of stratigraphic sections
- Goodell (1981) – Geology and U mineralization
- Cardenas (1983) – Volcanic stratigraphy and U deposits
- Magonthier (1985) – Volcanic stratigraphy and petrology
- Altamirano et al. (1988) – Economic geology study
- Reyes (1997) – Comprehensive geologic study

Alba and Chavez (1974)
Central Sierra Peña Blanca

LITHOLOGY	FORMATION
	QUATERNARY ALLUVIUM
	NOPAL FORMATION
	VITROPHYRE
	COLORADAS FORMATION
	VITROPHYRE
	POZOS FORMATION
	GLEN ROSE FORMATION
	UPPER TAMAULIPAS FORMATION

Reyes (1997)
Nopal I area

Nopal I Deposit

- Three wells drilled at site in 2003 to characterize rocks and permit sampling of water beneath the deposit
- Main portion of orebody located within Nopal and Coloradas Formations

Nopal I orebody
(Reyes et al., 1980)

Legend

- ✦ Existing Wells
- New Peña Blanca Boreholes

0 1 Km

Contour Interval = 20 Meters

Stratigraphic Refinements

- Thickness of Coloradas Formation (114 m) slightly greater than average thickness (90 m) reported by Reyes (1997)
- Thickness of Pozos Formation (108 m) similar to Nopal questa section (111.8 m) measured by Reyes (1997)

PB-3, 1, and 2 wells

Cross section modified from Percy et al. (1994)

PB-1 Well

- Well drilled immediately adjacent to orebody
- Water table encountered at a depth of 223 m
- Continuous NQ core (47.6 mm) collected down to 250 m
- Four stratigraphic units
 - > Nopal tuff
 - > Coloradas tuff
 - > Pozos conglomerate
 - > Cretaceous limestone

Nopal Formation

- **Densely welded, crystal-rich rhyolitic ash-flow tuff**
- **Cored section (0 – 22.3 m) highly altered**
 - > **Kaolinite**
 - > **Quartz**
 - > **Minor chlorite, smectite**
- **Highly brecciated mineralized zone, with Fe oxide/hydroxide fracture fillings**
- **Intensely altered basal vitrophyre (17.45 – 22.3 m)**
- **K-Ar age of 44.8 Ma (recalculated from Alba and Chavez, 1974)**

Photo width = 1.9 mm
Sample depth = 7.54 m

Coloradas Formation

- Welded, lithic-rich rhyolitic ash-flow tuff
- Cored section (114 m thick) has devitrified and oxidized matrix
- Similar alteration mineralogy to that observed for Nopal tuff
- Small fiamme observed in thin section

Photo width = 1.9 mm
Sample depth = 79.77 m

Pozos Formation

- Interbedded sandstone and conglomerate (108 m thick in cored section)
- Conglomerate clasts consist of fragments of volcanic rocks, limestone, and chert, with increase in volcanic fragments upsection
- Contains three thin (2 – 6 m) pumiceous tuff intervals (Corrales tuff)
- Zone of increased radioactivity present near water table

Conglomerate at 148.65 m

Pumiceous tuff at 187.05 m

Cretaceous Limestone

- **Fossiliferous micritic limestone**
- **Upper contact is at 244.4 m depth in PB-1 well (below water table)**
- **Contains calcite veins**
- **Limestone corresponds to uppermost Tamaulipas Formation or Cuesta del Cura Formation (mid-Cretaceous)**

Photo width = 1.9 mm
Sample depth = 247.72 m

Fractures and Veins

- Detailed surface fracture study (Pearcy et al., 1995) noted key role of fractures for U transport at Nopal I deposit
- Many fractures in PB-1 core are mineralized
 - > Hematite, limonite, goethite
 - > Silica
 - > Kaolinite
- PB-1 core and video log used to characterize fractures at depth

Televiewer image and corresponding core sample with breccia vein in Coloradas ash-flow tuff (~127 m)

Rock Property Characterization

- Measurement of key rock properties being conducted to constrain flow and transport models, including:
 - > Porosity
 - > Permeability
 - > Fracture density
 - > Mineralogy
 - > Ion exchange capacity
- Initial modeling work under way to evaluate seepage in mine adit within Nopal Formation

Conclusions

- Four main stratigraphic units intersected by PB-1 core
- Stratigraphic thicknesses similar to those reported by Reyes (1997)
- Characterization of fractures and key rock properties in progress for use as input in radionuclide transport modeling
- Flow and transport through these formations influenced by fracture network, rock properties
- Many similarities to Yucca Mountain make this a useful analogue for testing flow and transport models