Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10356, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10356
EGU General Assembly 2008

Dating long-term leakage of CO2 from fault damage zones

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Natural CO2 reservoirs in the Colorado Plateau region of the USA are natural analogues for geologic storage of anthropogenic CO2. In places, this CO2 has migrated to the surface along fault zones and man-made boreholes, forming CO2-charged springs and geysers. Dating of modern and ancient travertine mounds associated with these springs along two fault zones has constrained the varying position of fluid flow to the surface along the faults through time. Previous geochemical and structural analyses have shown that CO2-rich groundwater is stored in a series of shallow sandstone reservoirs capped by impermeable caprock, and that the CO2 moves to the surface through fractures in the footwall damage zone of the faults.

Uranium series dating of multiple travertine mounds constrains the timing of initial spring activity to earlier than ˜110,000 ka. The variation in ages between mounds along both faults shows that pathways for CO2-rich waters to the surface have switched repeatedly through time. Multiple dates from a single spring deposit show that an individual mound has a life span of at least 10,000 years. However, at least one location has three travertines with distinct ages that range over 40,000 years, suggesting that a single pathway can be re-used many times. These data allow us to constrain the spatial and temporal evolution of fluid flow pathways in the faults, and to estimate the rates and volumes of flow in individual pathways. Carbon Capture and Storage (CCS) could be a vital component to decrease carbon emissions on short time scales. However, the observation that leakage of CO2-rich groundwater from a fault can last for tens to hundreds of thousands of years has implications for geological storage of CO2.