

# Carbon storage in deep gold mines

A South African perspective

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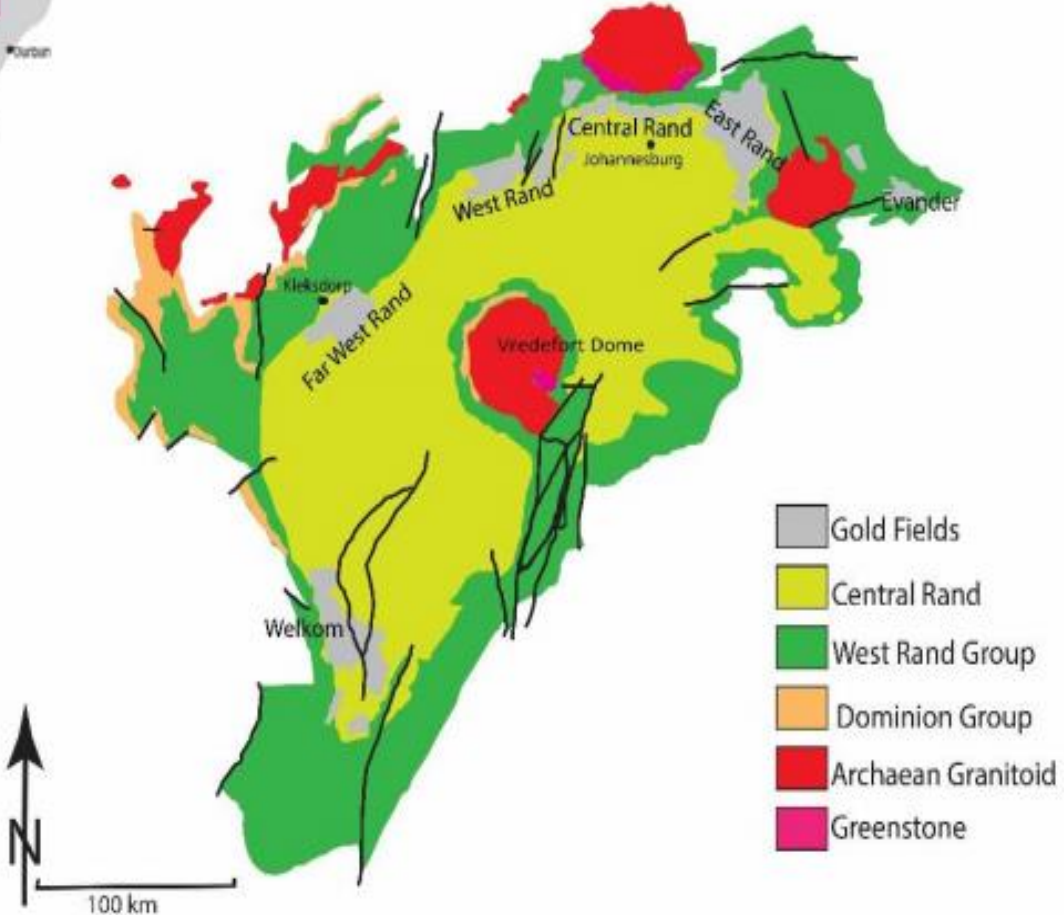


# Gold mining in South Africa

## WITWATERSRAND BASIN



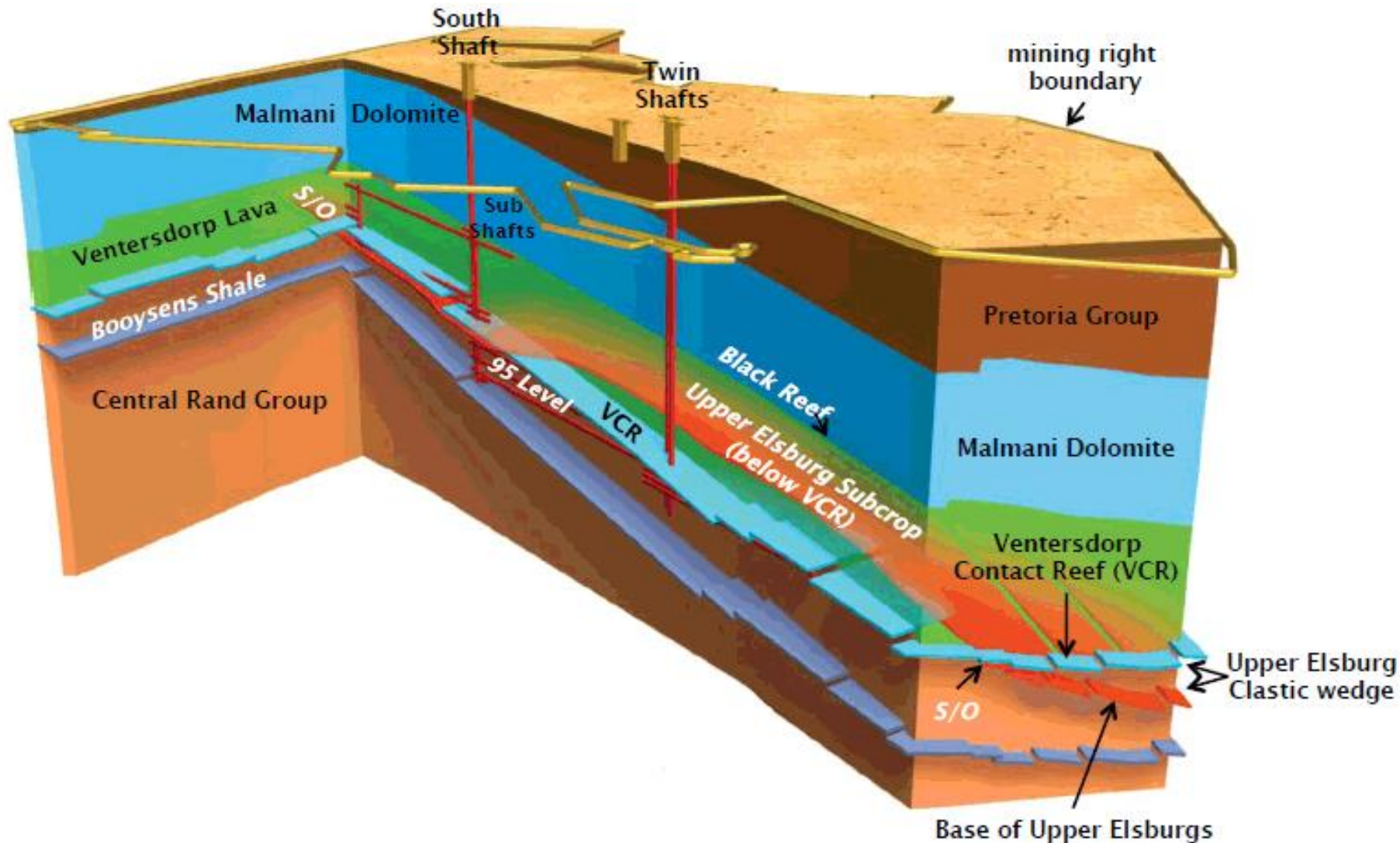
Time (Ga)	Lithology	Supergroup
2.1-2.35		Transvaal (3-5Km)
2.43-2.6		
2.71		Ventersdorp (3-5Km)
2.71-2.89		Witwatersrand (Central Rand: 3Km)
2.91-2.97		Witwatersrand (West Rand: 4Km)
3.07-3.06		Dominion (0-2.5Km)
>3.1		Archaen Basement Complex



Rock properties		Units
Lithologies: Quartzite (55%) Shale (45%)		
Average geothermal gradient	0.012	°C/m
Thickness (km)	4900	m
Heat Production at 2.06 Ga , $\mu\text{W}/\text{m}^3$	1.54	$\mu\text{W}/\text{m}^3$
Geological Depth	4739	m
Porosity/Permeability	Data not available	
Thermal Conductivity W/mK	5.13	W/mK
Density	2700	kg/m3
Heat Capacity Jkg/K	825	Jkg/K



# Anatomy of a deep gold mine



- » Operation takes place at approx. depths of between 2400-2650m below surface
- » Operations of this nature typically require high energy consumption
- » Energy accounts for 40-60% of mining operating costs
- » Infrastructure in place and shafts exist which can be leveraged on





# Passive Underground Mine-water Purification (PUMP) Model

## Black and White Smokers

Black Smoker, 150 - 400,  
Predominantly pyrite and  
other metal sulfides

White Smoker, <150,  
Anhydrite, pyrite and  
other metal sulfides

3 000m

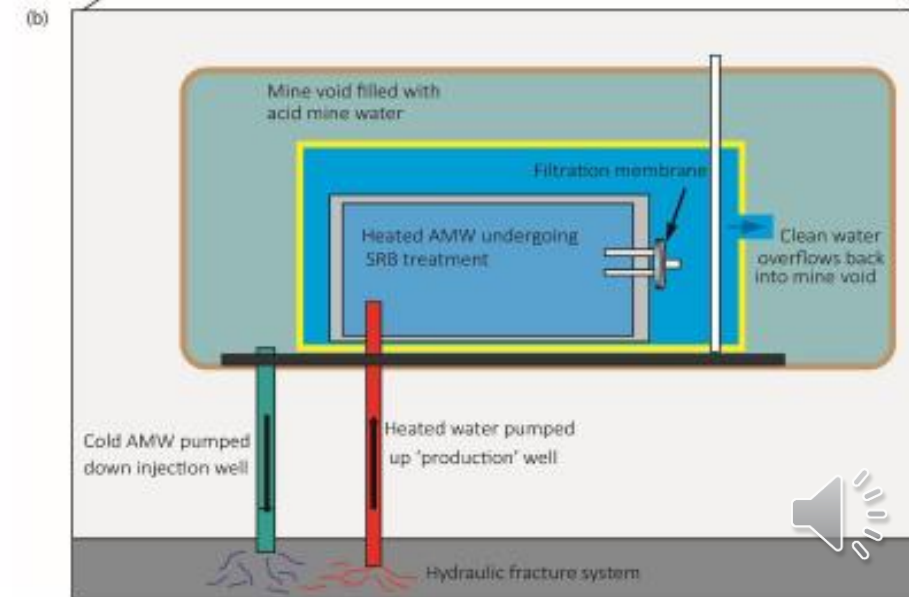
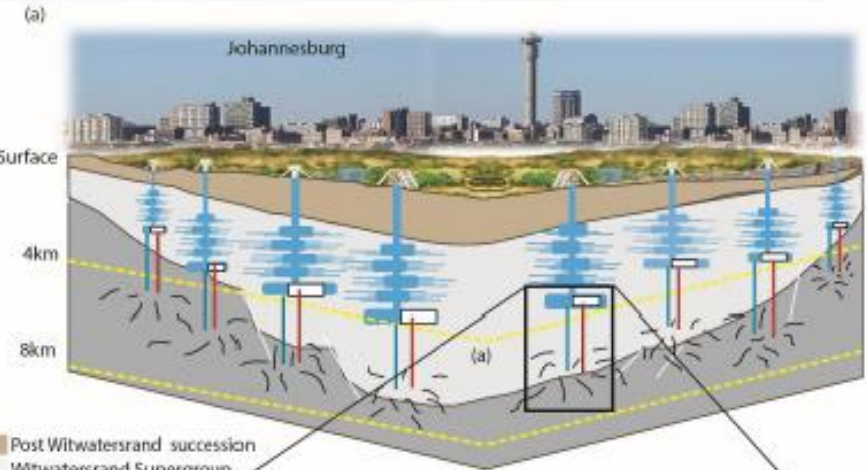
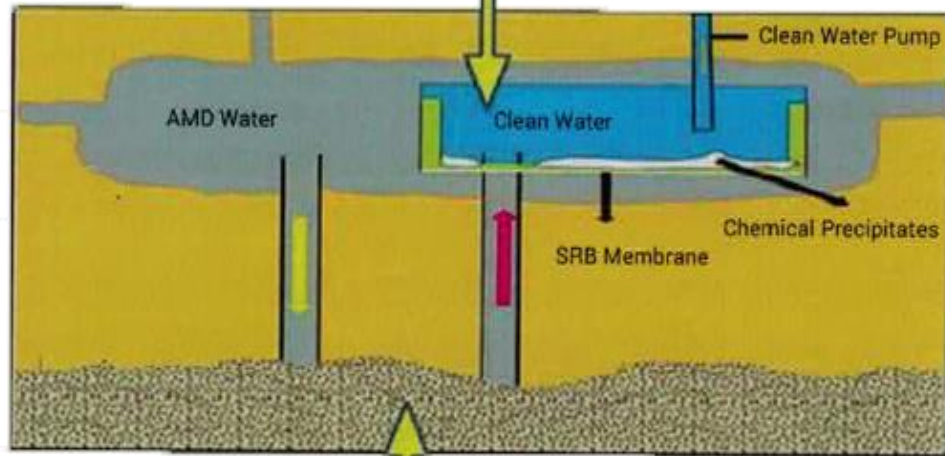
100m

## Geothermal Well System

Generating station

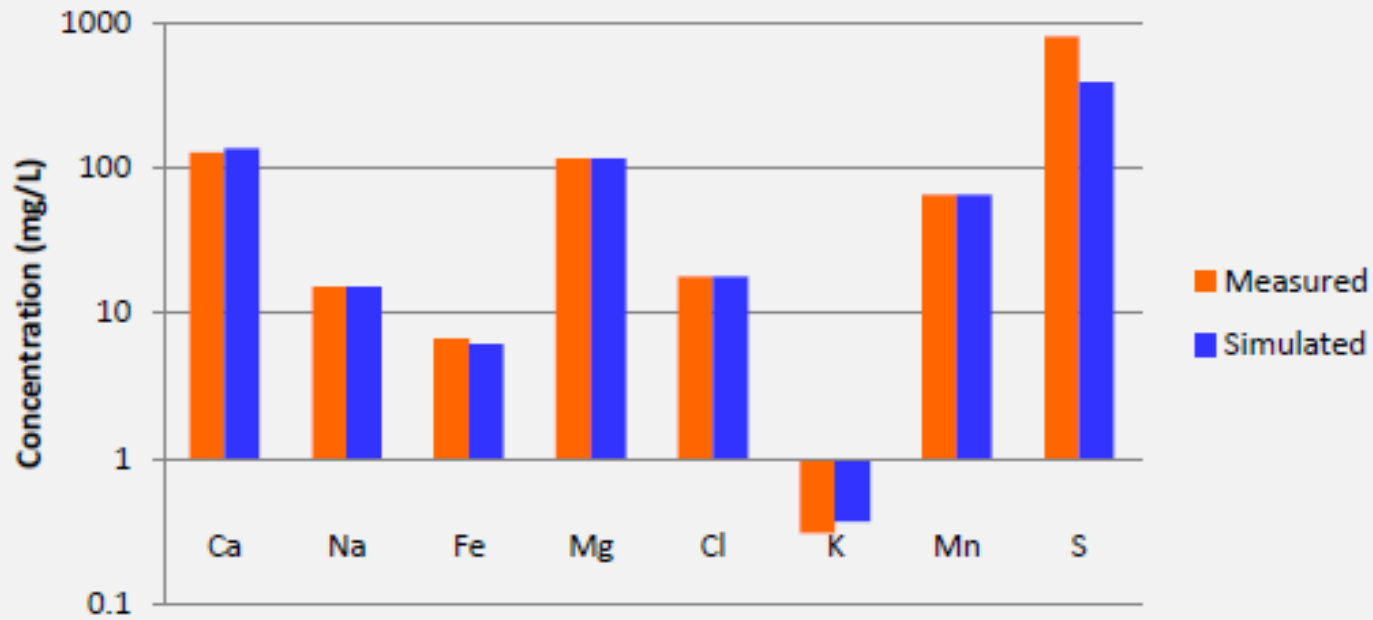
Cold water  
pumped down

Steam and  
hot water

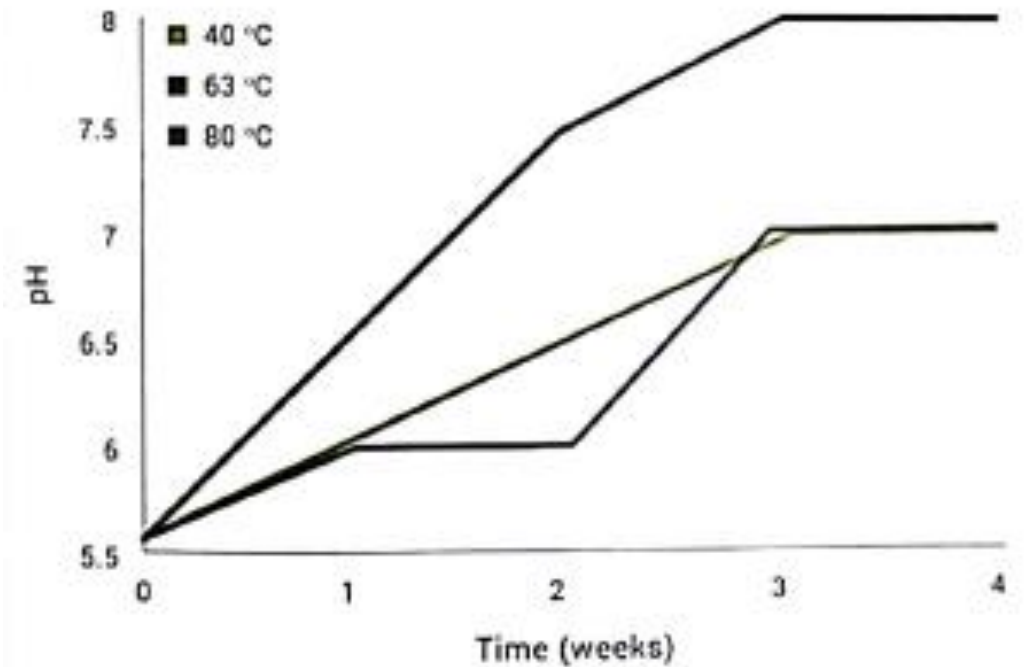


## Preliminary results

Comparison of concentrations measured by ICP-AES and PhreeqC simulation



Effect of bacterial sulphate reduction on pH over time



# CO<sub>2</sub> introduction into PUMP system



- » PUMPs is designed for the remediation of acid mine water in voids of abandoned gold mines in the Witswatersrand basin
- » Captured carbon dioxide can be introduced into the system by bubbling it slowly through a diffuser which gently releases the gas into the water