

# Celestine in Yemen

**Significant concentrations of celestine, montmorillonite and attapulgite minerals in the eastern parts of Yemen are considered to be of economic interest.**

## Geological setting

Celestine is mainly found in shales of Tertiary age, where it is believed to have precipitated very near the shoreline, probably in lagoons. Originally, celestine formed either the skeletons of radiolarians as *Collospæra* and *Podactinelia* or it appears as  $Sr^{2+}$  in aragonite crystal lattice.

During diagenesis, radially fibrous rosettes were formed reaching up to 30 cm. In nodular limestone of the Umm Ar Radumah formation, fossils are preserved by celestine.

## Celestine occurrences

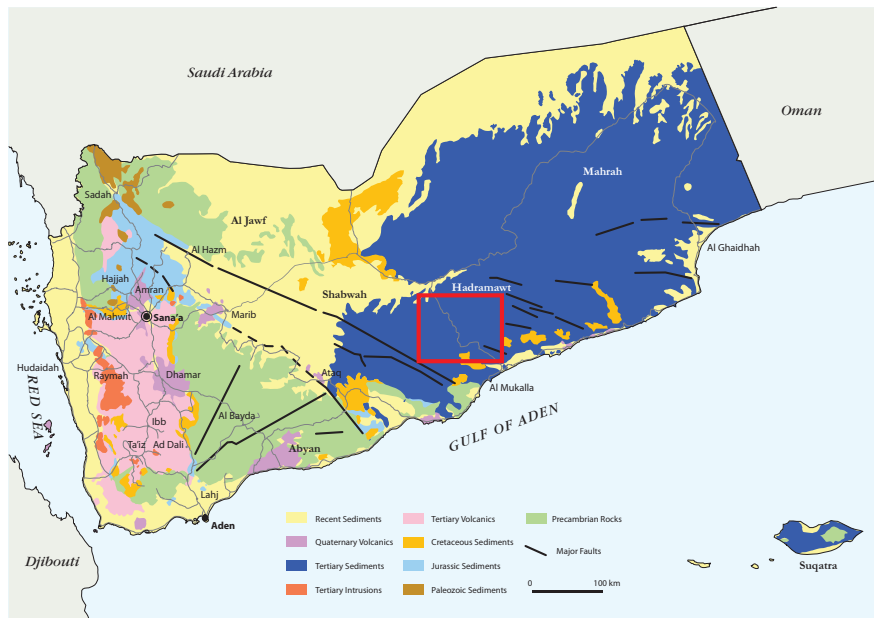
The celestine occurrences located on the Hadramawt plateau and situated about 70 km north of the city of Mukalla, occupy a surface of about 200 km<sup>2</sup>.

Celestine crystals are very pure and occur scattered in clay beds composed of montmorillonite-attapulgite.

Celestine-bearing beds vary in thickness between 1 and 8 metres, generally they contain less than 1% celestine. Locally grades of 5% celestine are seen.

Analyses of bulk samples gave the following results:

| SrSO <sub>4</sub> | BaSO <sub>4</sub> | CaO  | Fe <sub>2</sub> O <sub>3</sub> |
|-------------------|-------------------|------|--------------------------------|
| 99.10             | 0.27              | 0.37 | 0.07                           |
| 98.60             | 0.02              | 0.21 | 0.17                           |
| 99.01             | 0.05              | 0.13 | 0.09                           |
| 98.50             | 0.03              | 0.13 | 0.07                           |
| 99.40             | 0.10              | 0.10 | 0.04                           |
| 98.73             | 0.04              | 0.11 | 0.19                           |
| 99.02             | 0.06              | 0.15 | 0.06                           |



Geological sketch map of Yemen. The red square indicates the area of the most promising celestine occurrences.



Celestine intrusion in clay layer.

## Montmorillonite and attapulgite occurrences

The montmorillonite-attapulgite deposits are located on the Hadramawt plateau and situated about 70 km north of the city of Mukalla. The deposit occupies a surface of about 15,000 km<sup>2</sup>.

The deposit is situated at the top of the Jiza formation consisting of calcareous shales. The effective thickness reaches 1.2 m.

The colours of the montmorillonite-attapulgite range from pure white to clear grey or yellowish.

The deposit contains to 62% montmorillonite and 20% attapulgite. Bulk composition is 55.6% SiO<sub>2</sub>, 14.6% Al<sub>2</sub>O<sub>3</sub>, 5.9% Fe<sub>2</sub>O<sub>3</sub>, 3.2% MgO, 2.6% K<sub>2</sub>O, 1.4% Na<sub>2</sub>O and 1.4% CaO.



Pure crystalline celestine.

### Physical properties

Laboratory tests have been carried out on different samples (sample weight 2 kg) in order to measure the physical properties. The viscosity of aqueous emulsions is within the range which is suitable for drilling-mud. The capacity for absorbing oil has shown very good results (67.90–90.90%), with moisture ranges from 2.70% to 10.40% and residue on 200 mesh between 1.40–8.40%.

Mud of three different concentration ranges between 3.5 and 8 g/100 ml has given the following properties:

- Apparent viscosity ranges from 8.5 to 25 pc
- Initial gel strength ranges from 6 to 20 lb/sqf
- Final gel strength ranges from 8 to 25 lb/sqf.

According to the montmorillonite-attapulgite contents it can be regarded as bentonite. The deposit has the same properties as fuller's earth, foundry clay and rinsing clay.

Besides, it can be used for the following applications:

- Preparation of drilling mud
- Carriers and absorption material
- Filter material
- In paper production.



Ministry of Oil & Minerals  
Yemen Geological Survey  
and Mineral Resources Board

Dear Investors

We take this opportunity to welcome you to Yemen.

We promise to make every possible effort to give you all required information in the mineral sector in Yemen.

If you face any problems or need any assistance, please don't hesitate to contact us on the following address:

P.O. Box 297  
Sana'a - Yemen

Tel.: (00967) 1 211 818  
Fax.: (00967) 1 217 575

ygsmrb@ygsmrb.org.ye  
www.ygsmrb.org.ye

We are looking forward to your mining investments in Yemen.

*Evaluation & Promotion  
General Department*

Editing and graphics production:

GEUS

Printed:

January 2009

Printers:

GEUS Print