

# Rock Salt in Yemen

*Rock salt deposits are common in both Mesozoic and Cenozoic rocks. Open pit mining operations date back at least to the Turkish occupation of 1538.*

## Geological setting

Rock salt occurs as salt domes within the Sab'atayn Formation (Amran Group) of upper Jurassic age, and within the Salif Formation (Tihamah Group) of Late Tertiary age. The rock salt alternates with gypsum, anhydrite and clay. It is white and grey in colour, massive and overlain by bituminous shales and gypsum.

## Al-Hudaidah

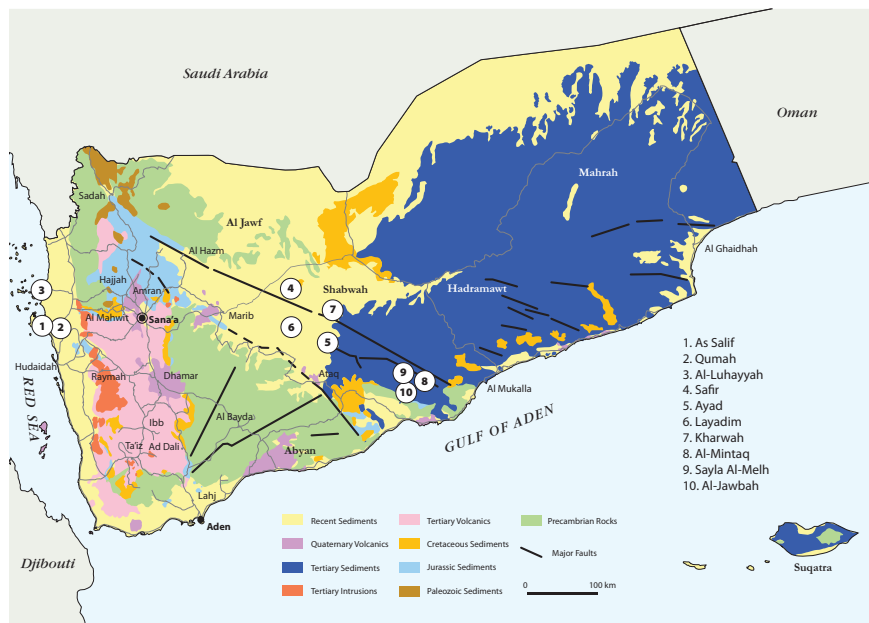
Salt domes of Miocene age occur along the Red Sea coast from south-east of Al-Hudaidah to Al-Luhayyah. The most important deposit is in the As Salif area.

## The As Salif area

The rock salt is situated about 75 km north-west of Al-Hudaidah. The salt body is overlain by gypsum and gypsiferous shale in the central ridge area.

The salt body of Salif consists of banded halite. White to clear 10 to 20 cm bands alternate with thin (2 cm) dark bands. 183 chemical analyses were carried out on the salt intersection of boreholes. The average chemical composition is: 38.6% Na, 59.53% Cl, 0.014% K, 0.39 Ca, 0.006% Mg, 0.87% SO<sub>4</sub>, 0.38% water insoluble and 98.12% NaCl. Also 10 representative grab samples were analysed and the average values are: 0.38 water insoluble, 0.63% SO<sub>4</sub>, 0.001% CaO and 5.4% alumina insoluble.

The reserve estimates cover an area of 680 000 m<sup>2</sup>, and with an exploitable depth of 30 m, the mineable volume is 43 million ton. The overburden rarely exceeds 10 m. If the exploitable depth can be increased to 50 m, the mineable volume will increase to 72 million ton. In addition,



Geological sketch map of Yemen, showing the most promising rock salt occurrences.



Salt crystals.

the reserve volume will be 115 million ton, if the exploitable depth can be increased to 80 m.

Similar deposits are exposed in salt domes along the Red Sea in the Qumah and Al-Luhayyah areas. These deposits are mined by small-scale miners for local use.

### Shabwah and Marib

The salt domes in the Shabwah and Marib areas are mined on a small scale for local use. Salt units up to 200 m in thickness have been reported in oil wells in the Marib-Jawf basin. The rock salt occurs within the Sab'atayn Formation (Amran Group) of upper Jurassic age.

### The Safir area

The rock salt is found about 109 km north of Marib city. The rock salt occurs as salt domes exposed over about 5 km<sup>2</sup>. The rock salt occurs in coarse-crystal, colourless, transparent to white, occasionally grey or black varieties. According to chemical analyses, the NaCl content, varies from 93.21 to 99.13%, with 36.12–40.73% Na, 56–60.80% Cl, 0.06–0.43% SO<sub>3</sub>, 0.12–2.02% water insoluble. The reserves of salt rock are estimated to be about 25 million m<sup>3</sup>.

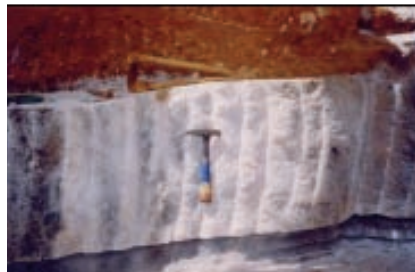
### The Ayad area

The rock salt is situated about 70 km north of Ataq city. In the central part of the salt dome, which is 3.9 x 1.5 km in size, there are numerous salt pits over an area of about one km<sup>2</sup>, which are exploited by small-scale miners. The rock salt occurs in coarse-crystal (crystals up to 12 cm in size), colourless, transparent, less frequently white, occasionally grey, brown, or black varieties.

The NaCl content, according to the chemical analyses, varies from 88.33 to 98.61%, with 35.38–38.75% Na, 53.17–59.02% Cl, 0.69–3.01% SO<sub>3</sub>.

### The Kharwa area

The rock salt is situated about 115 km north of Ataq city. The central portion of the dome accommodates salt pits in which rock salt is mined by local miners. Drilling has confirmed salt to a depth of at least 3000 m. The NaCl content, according to the chemical analyses, varies from 95.62 to 98.11%, with 38.75–40.43% Na, 56.72–58.49% Cl, 0.54–1.27% SO<sub>3</sub>.



Similar occurrences are found exposed in salt domes at the Layadim area where the rock salt is situated about 250 km north of Ataq city, in addition to Al-Jawbah and Sayal Al-Melh occurrences south-east of the Layadim salt dome. The composition is similar to that from the Ayad and Kharwah deposits.

### Hadramawt

#### The Al-Mintaqa area

The rock salt is situated about 100 km north-west of Al-Mukalla city. The rock salt is coarse-crystalline bearing porphyroblasts up to 4 cm, in size. It is grey to colourless. Bedding structures are marked by thin clay bands which appear at 10 to 30 cm intervals. The surface of the salt diapir covers an area of 200 x 250 m, partly covered by 5 m of overburden. The NaCl content, according to chemical analyses, varies from 91.48 to 96.1%.



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