

# Scoria in Yemen

*Most of the scoria deposits in Yemen are characterised by high porosity, low, specific gravity and great strength.*

*According to its chemical composition, the scoria in Yemen is analogous to the volcanic rock, used by the construction industry as active mineral additives in Portland-pozzolan cement production. As to its physical and mechanical properties, the scoria meets the requirements of the industry for aggregates for lightweight construction concretes.*

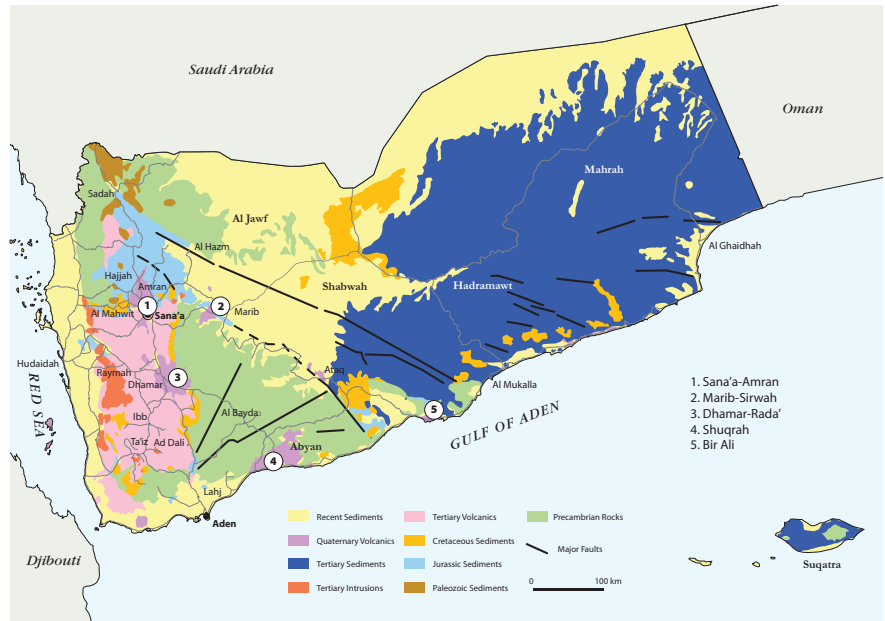
## Geological setting

Strombolian-type explosions have formed numerous scoria pyroclastic cones within the basaltic lava in the Quaternary volcanics. The Quaternary volcanic activity occurred in discrete volcanic fields all over Yemen. The scoria deposits are found in five volcanic fields: Sana'a-Amran, Dhamar-Rada', Balhaf-Bir Ali, Shuqrah, and Marib-Sirwah.

### Sana'a-Amran volcanic field

The Sana'a-Amran scoria deposits are situated about 11 km north-west of Sana'a city and extend east to the Rada' town for 70 km, covering a widespread area of about 800 km<sup>2</sup>. The deposits are composed of black, red-brown with violet hue, loose, porous, and lightweight scoria. The average chemical composition is: 45.15% SiO<sub>2</sub>, 16.19% Al<sub>2</sub>O<sub>3</sub>, 11.52% Fe<sub>2</sub>O<sub>3</sub>, 8.54% CaO, 6.42% MgO and 3.12% Na<sub>2</sub>O.

The average density of the scoria is 1.54 g/cm<sup>3</sup>, with a compressive strength amounting to 55.30-63.60 kg/cm<sup>2</sup>. The total reserves of the Sana'a-Amran scoria deposits are estimated to be about 411 million m<sup>3</sup>.



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



Thick deposit of scoria - Sana'a - Amran Volcanic field.

### Dhamar-Rada' volcanic field

The Dhamar-Rada' scoria deposits are located about 20 km east of Dhamar city and extend east to the Rada' town for 50 km, covering a widespread area of about 1300 km<sup>2</sup>. The scoria cones in this field are 13-174 m high and less than 1 km in basal diameter rising to some 200 m above ground level. The scoria is vesicular, fine- to coarse-grained fragments, red-

dish or black in colour and lightweight.

The average chemical composition of the scoria rocks at Dhamar-Rada' is: 45.00-51.14% SiO<sub>2</sub>, 15.27-18.40% Al<sub>2</sub>O<sub>3</sub>, 10.05-14.70% Fe<sub>2</sub>O<sub>3</sub>, 7.20-12.05% CaO and 2.80-4.20% Na<sub>2</sub>O. The density values range from 764 to 820 kg/m<sup>3</sup>. The water absorption capacity ranges from 30 to 38%. The compressive strength values



Thick layer of scoria, Dhamar-Rada' volcanic field.

range from 50.20 to 54.60 kg/cm<sup>2</sup>. The total reserves of the scoria deposits are estimated to be about 495 million m<sup>3</sup>.

### Balhaf-Bir Ali volcanic field

The Balhaf-Bir Ali scoria deposits are situated about 136 km south-west of Al-Mukalla city. A layer of loose, porous, light scoria builds up three individual hills up to 29 m high and 200 to 500 wide. The thickness of loose slag amounts to 32 m, massive compact cemented scoria occurring below it.

The density values range from 1400 to 1900 kg/m<sup>3</sup>. The water absorption capacity ranges from 8 to 17.95%. However, the compressive strength values range from 9.29 to 19.29 kg/cm<sup>2</sup>. The average chemical composition of the scoria is: 44.79% SiO<sub>2</sub>, 15.89% Al<sub>2</sub>O<sub>3</sub>, 10.3% Fe<sub>2</sub>O<sub>3</sub>, 9.9% CaO, 7.7% MgO, 0.4% SO<sub>3</sub>, 0.7% K<sub>2</sub>O and 2.2% Na<sub>2</sub>O. The scoria deposit reserves amount to 867 000 m<sup>3</sup>. 18 cones composed of scoria with similar composition are known within Balhaf-Bir Ali.

### Shuqrah volcanic field

The Shuqrah scoria deposits are situated about 130 km north-east of Aden city. Several volcanic cones are known and one of them has been prospected. The Shuqrah scoria deposit forms a hill with a relative height of 90–95 m. The hill has morphology typical for volcanoes with a partly truncated cone, opening in south-western direction. Geological studies have

been conducted in the 0.3 km<sup>2</sup> large area. The scoria deposit is composed of red-brown with violet hue, loose, porous, lightweight volcanic slag, with rare inclusions of fragments of caked slag from 10 to 15 cm in size. The density values of the scoria range from 650 to 1000 kg/m<sup>3</sup>. The compressive strength values range from 6 to 39 kg/cm<sup>2</sup>. The total reserves of the Shuqrah deposit are estimated to be about 7.6 million m<sup>3</sup>.

### Marib-Sirwah volcanic field

The Marib-Sirwah scoria deposit is situated about 173 km north-east of Sana'a city. It is composed of about 100 scoria cones and basaltic lava flows. The scoria cones in this field are 19–170 m high, with basal diameters from 110 to 1400 m. These deposits are reddish, sometimes grey, with lapilli and rare, small volcanic bombs.

The average chemical composition of the scoria at Marib-Sirwah is: 40.00–46.0% SiO<sub>2</sub>, 11.60–17.20% Al<sub>2</sub>O<sub>3</sub>, 9.60–12.00% Fe<sub>2</sub>O<sub>3</sub> and 7.30–12.00% CaO. The density values range from 1.45 to 1.96 g/cm<sup>3</sup>. The water absorption capacity ranges from 28 to 35%. However, the compressive strength values range from 34.40 to 35.60 Mega Pascal.

The total reserves of the scoria deposits in Marib-Sirwah are estimated to be about 925 million m<sup>3</sup>.



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