

# UK frac sand resources

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**British  
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



# Minerals at the BGS



Clive at a silica sand quarry in Hampshire

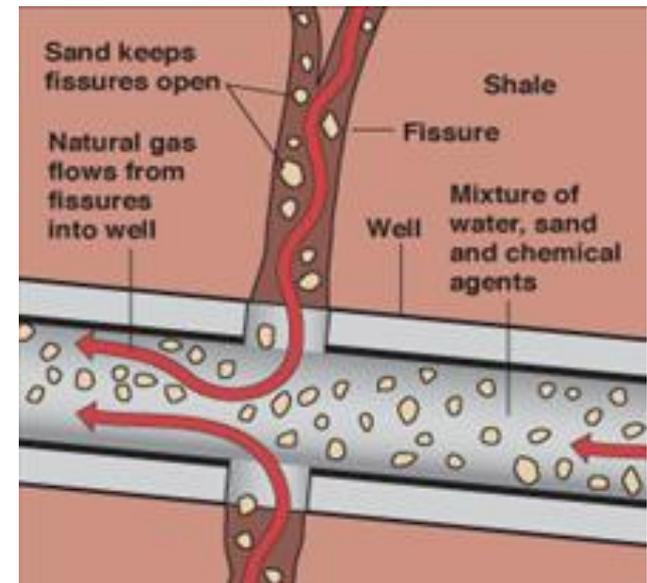
<http://www.bgs.ac.uk/staff/profiles/1159.html>

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- We are a major provider of spatial mineral resource information in the UK
- We carry out UK & International research in metallogenesis, land-use impacts of mineral extraction, resource security, industrial minerals and geomaterials
- We provide BGS minerals information as data tables, reports, maps, profiles and factsheets as FREE downloads via [www.mineralsUK.com](http://www.mineralsUK.com)

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# What is Frac Sand?

- Silica sand used in hydraulic fracturing treatments to 'prop' open fractures in oil & gas reservoirs to enhance recovery
- Also known as 'Proppant' sand
- Silica sand is composed of high-purity quartz ( $\text{SiO}_2$ ) sand
- Alternatives – resin coated sand and ceramics (made from calcined kaolin or bauxite)



BRITISH STANDARD

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BS EN ISO  
13503-2:2006  
+A1:2009

# Petroleum and natural gas industries — Completion fluids and materials —

## Part 2: Measurement of properties of proppants used in hydraulic fracturing and gravel-packing operations

ICS 75.100

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**BSi**  
British Standards

**BS EN ISO 13503-2:2006 + A1:2009** This standard covers measurement of the properties of proppants and also the specifications for proppants (it is related to **API RP-56:1995**)

# Frac sand properties

Property	Limits
Composition	>99% Silica, SiO <sub>2</sub> (Quartz or resin coated quartz) or 100% ceramic
Particle-size	Narrow size-distribution - 90% within specified size ranges e.g. 12 / 20 # (1700 – 850 microns)    20 / 40 # (850 – 425 microns) 40 / 70 # (425 – 212 microns)    70 / 140 # (212 – 106 microns)
Particle-shape	Well-rounded, spherical grains (>0.6 for quartz sand and >0.7 for resin coated sand and ceramic proppants)
Crush resistance	Withstand compressive stress 4000 - 6000 psi (28 - 42 MPa), determined at 10% crush material
Acid solubility	Limits on acid soluble material (<2% ≥30/50, <3% <30/50, <7% for resin coated sand or ceramic proppants)
Turbidity	Limits on clay (<2 microns) and silt (2 - 63 microns) content, maximum turbidity 250 FTU (Formazin Turbidity Unit)

**BS EN ISO 13503-2:2006 + A1:2009** Petroleum and natural gas industries. Completion fluids and materials. Measurement of properties of proppants used in hydraulic fracturing and gravel-packing operations (related to **API RP-56:1995**)

# Frac sand sporting analogy



**Footballs** = 20/40  
(850 – 425 microns)



**Tennis balls** = 40/70  
(425 – 212 microns)

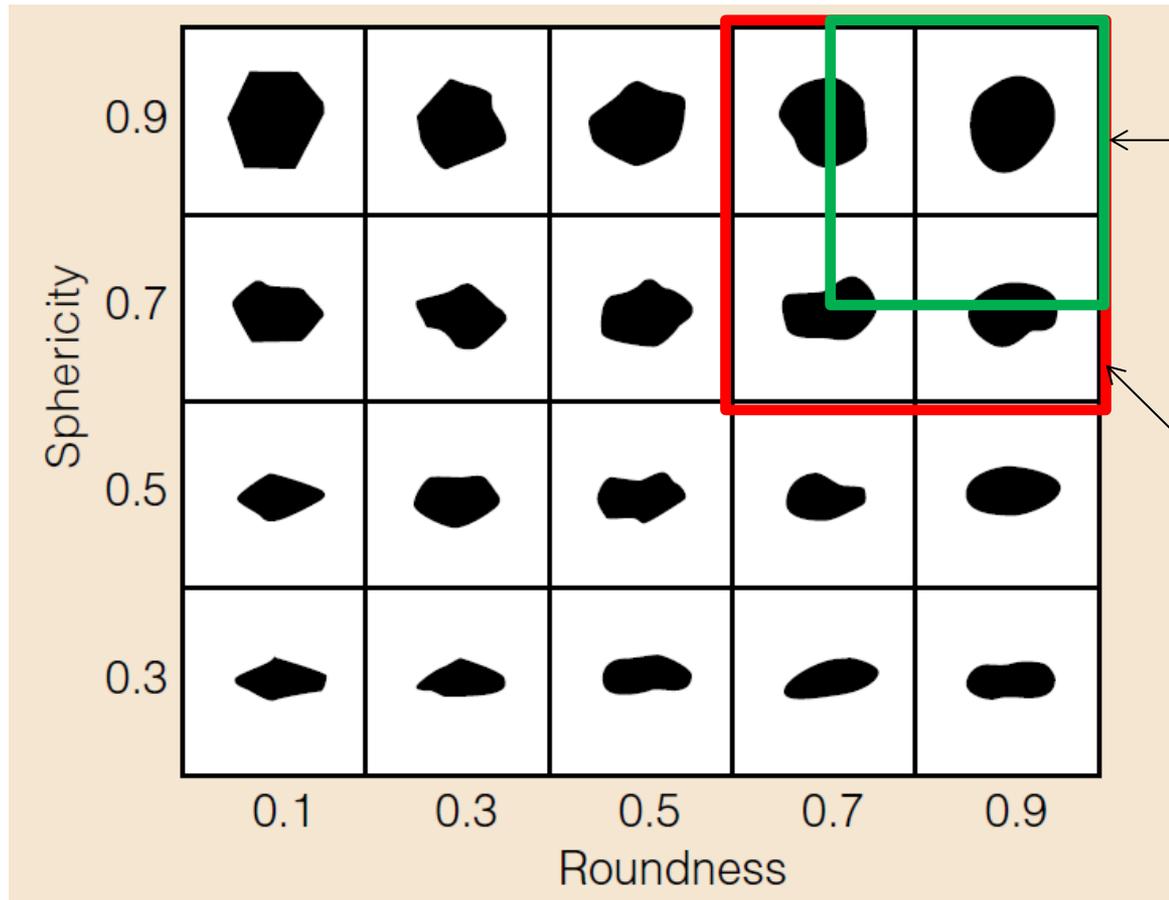


**Golf balls** = 70/140  
(212 – 106 microns)



**NB** Ratios are roughly equivalent between the diameters of the balls and those of the sand grains

# Roundness & Sphericity



0.7 Sphericity & 0.7 Roundness for resin coated sand & ceramic proppants

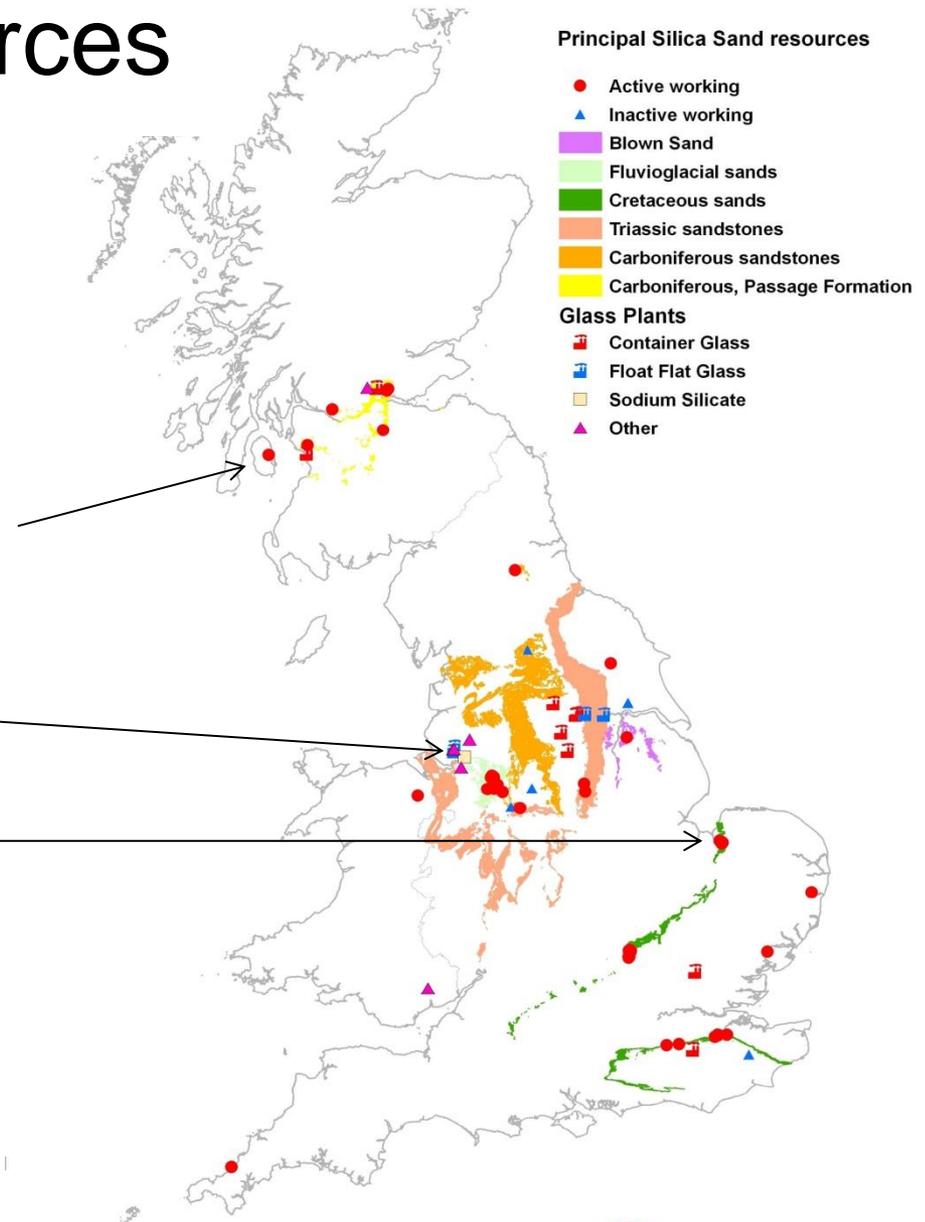
0.6 Sphericity & 0.6 Roundness for Frac Sand

**Reference:** Krumbein, WC & Sloss, LL (1963) Stratigraphy and Sedimentation, 2<sup>nd</sup> Edition (Freeman, San Francisco)

# UK silica sand resources

- The UK is nearly self-sufficient in silica sand
- 40 quarries produce 4Mt of silica sand (2010 figures\*)
- Sandstone (weakly cemented) e.g. Carboniferous Passage Fm , central Scotland (glass)
- Glacial sand e.g. Pleistocene Chelford Sand F<sup>m</sup>, Cheshire (flat glass)
- Near shore marine/ coastal (dune / beach) sand e.g. Lower Cretaceous Sandringham Sands F<sup>m</sup>, Leziate, Norfolk (glass)
- Alluvial (river), lacustrine (lake), aeolian (wind blown) sand

Silica Sand resources in the UK



\* UK Minerals Yearbook [www.MineralsUK.com](http://www.MineralsUK.com)

# UK frac sand resources?

- Where will the frac sand come from?
- Foundry sand is a close equivalent - requires high quartz content (98%), round grains with good sphericity, narrow size distribution and free of clay
- 20 quarries produce foundry sand in UK
- For this presentation I'll focus on three potential sources:
  - Chelford & Congleton Sands (Cheshire)
  - Woburn Sand Formation (Bedfordshire)
  - Folkestone Formation (Hampshire, Surrey & Kent)



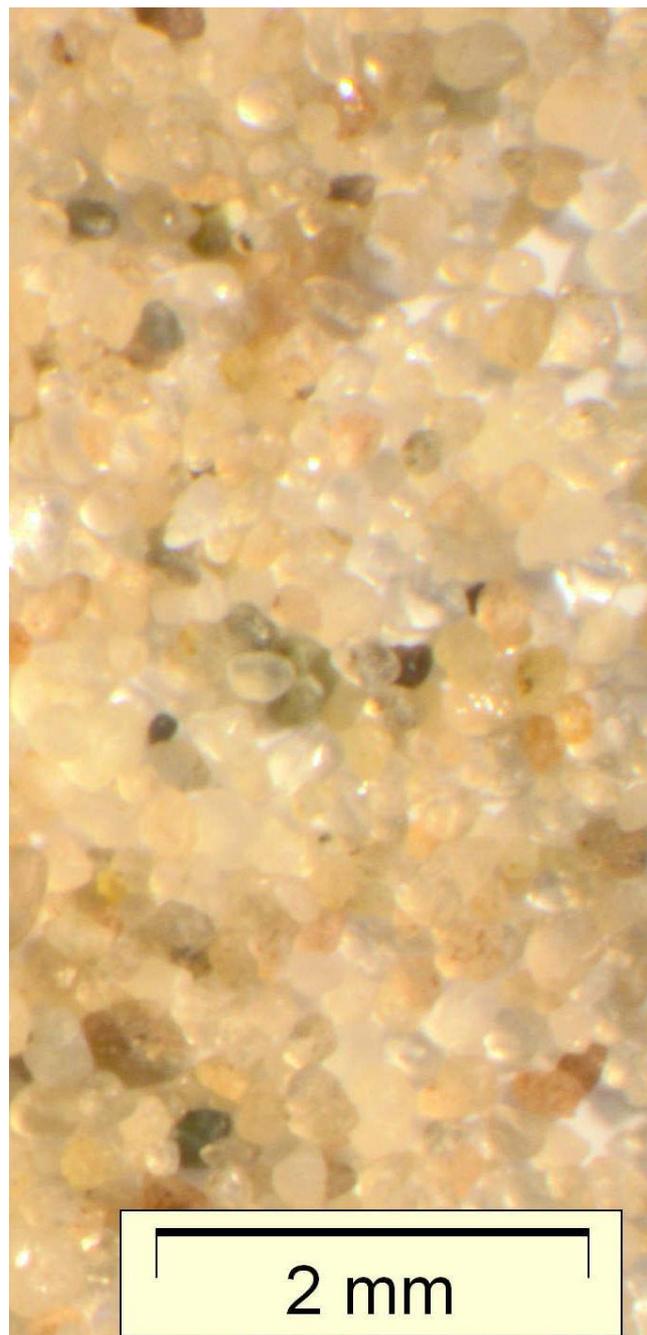
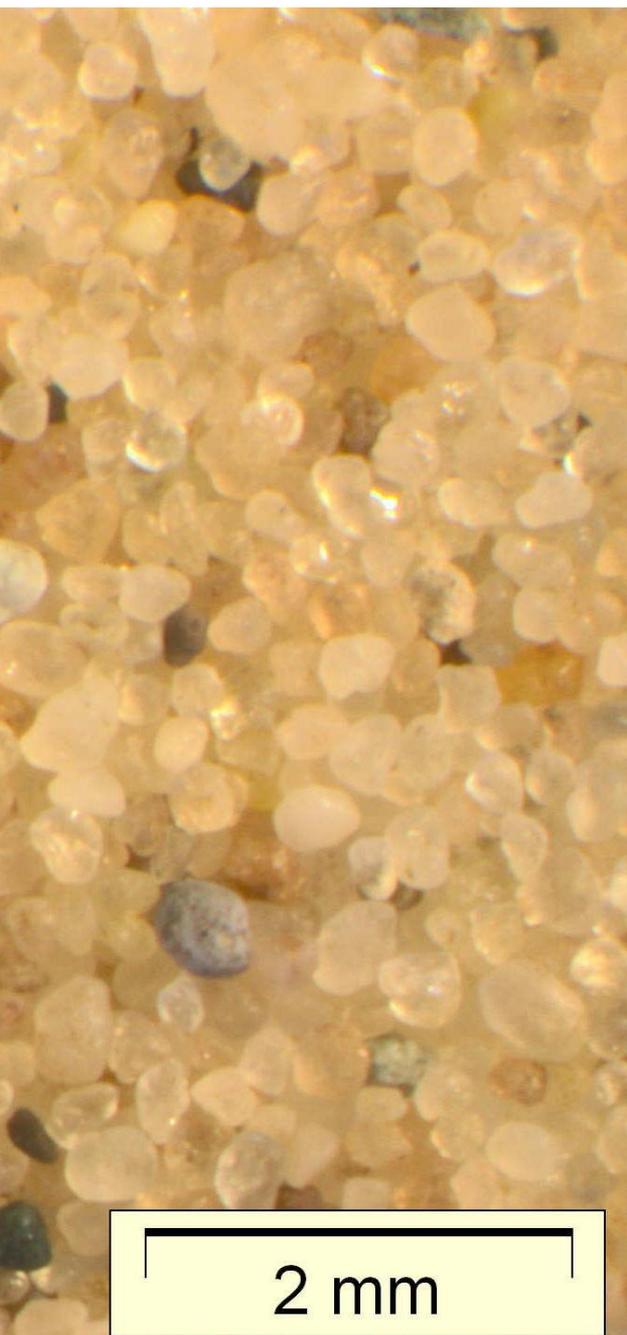


Congleton Sand: Silica sand quarry, Cheshire, UK



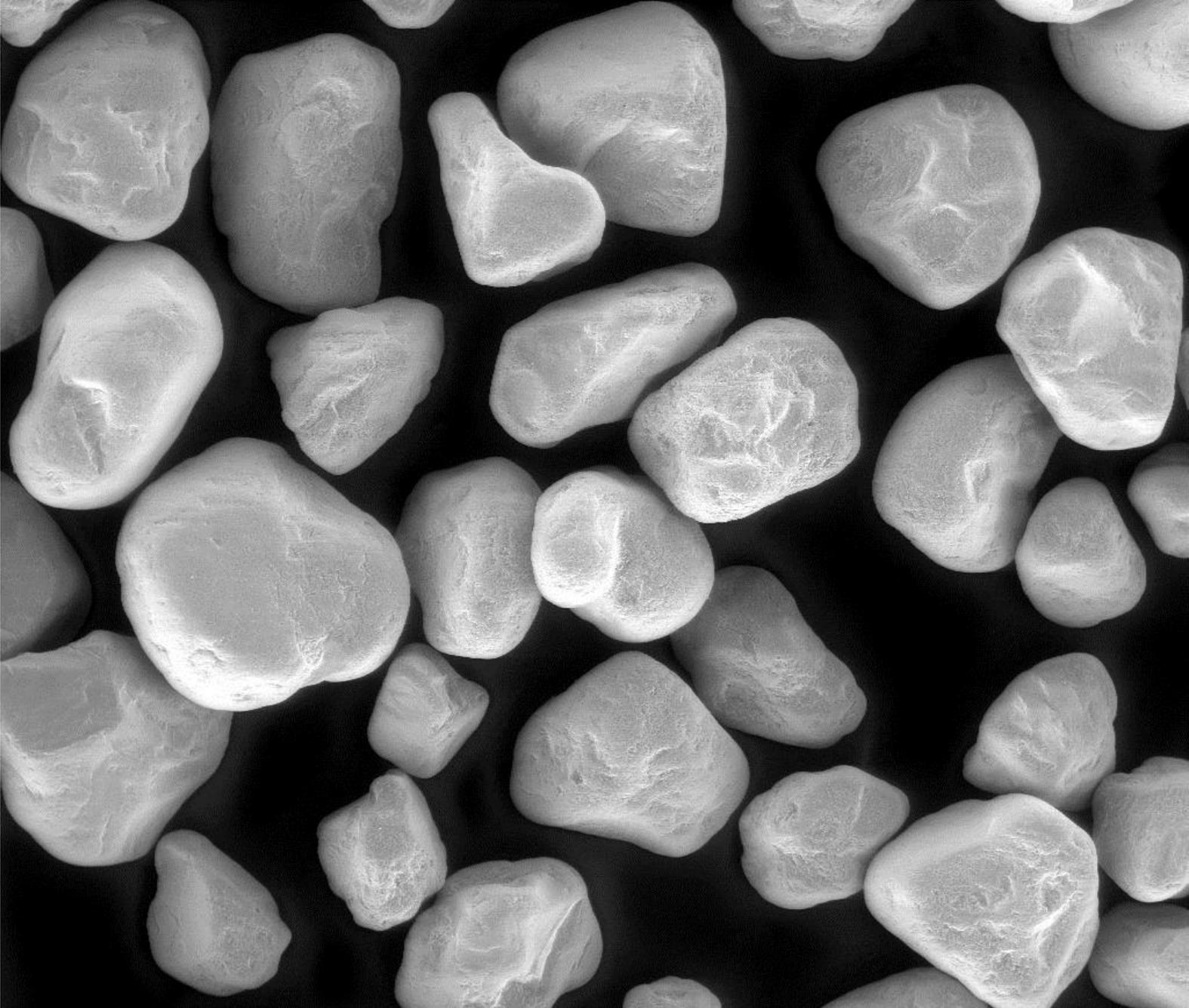
Congleton Sand: Silica sand quarry, Cheshire, UK

Congleton Sand





**Congleton  
Sand**



curr	HV	det	WD	vacMode	pressure
0.95 nA	10.00 kV	LFD	18.6 mm	Low vacuum	5.99e-1 Torr

500  $\mu$ m



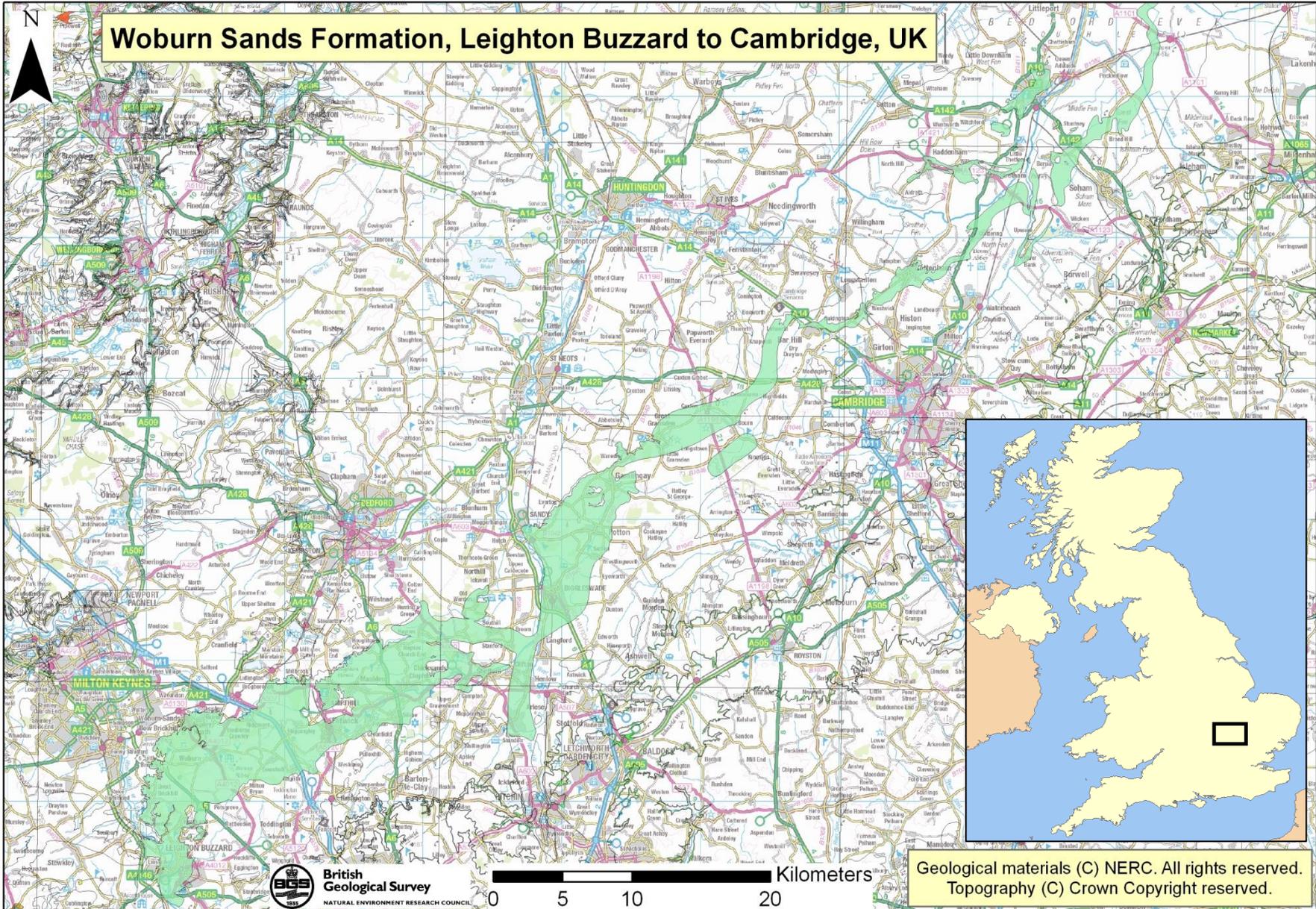
**Congleton Sand**



curr	HV	det	WD	vacMode	pressure
0.95 nA	10.00 kV	LFD	18.6 mm	Low vacuum	6.02e-1 Torr

— 100 μm —

# Woburn Sands Formation, Leighton Buzzard to Cambridge, UK



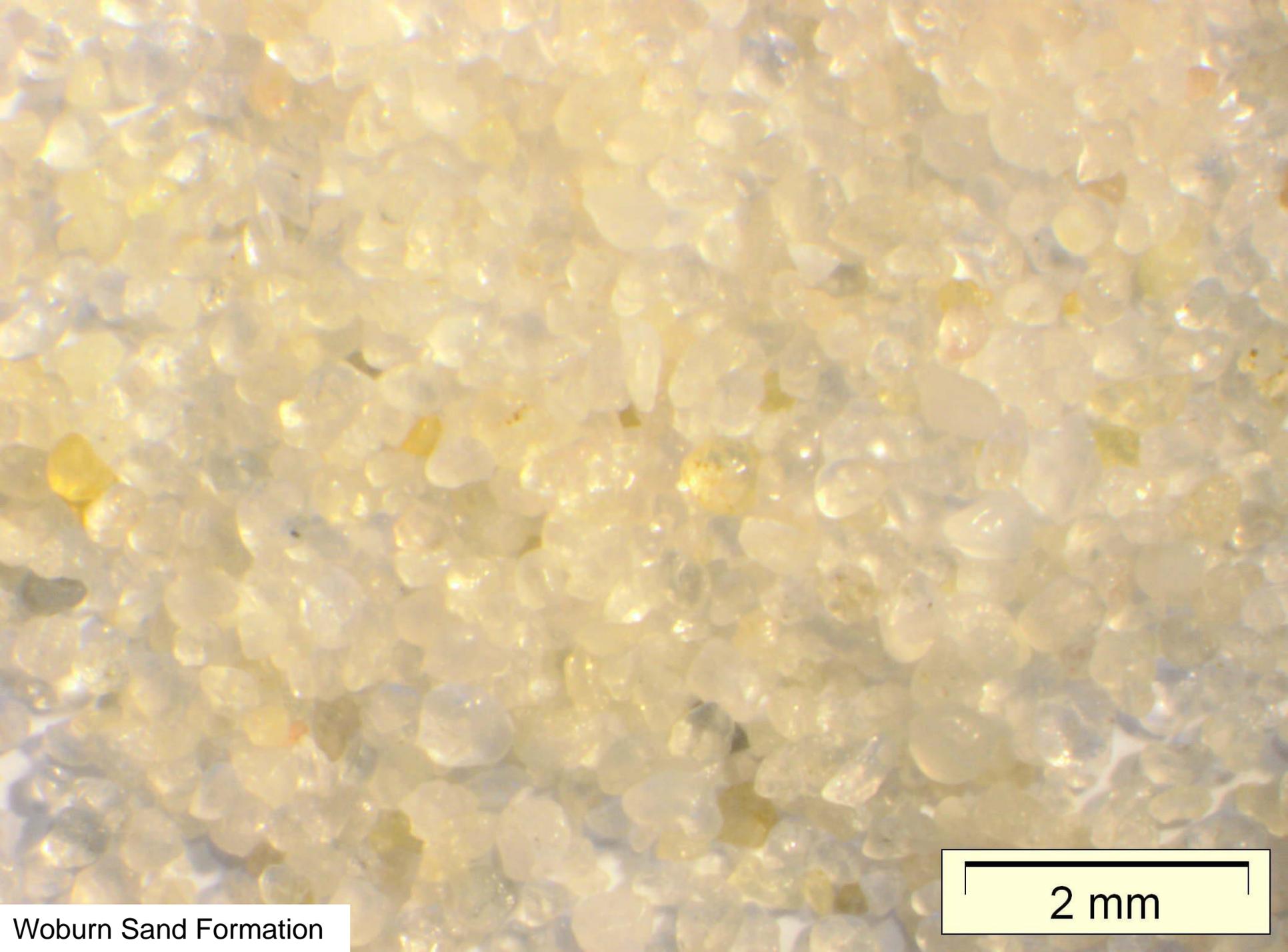
British Geological Survey

0 5 10 20 Kilometers

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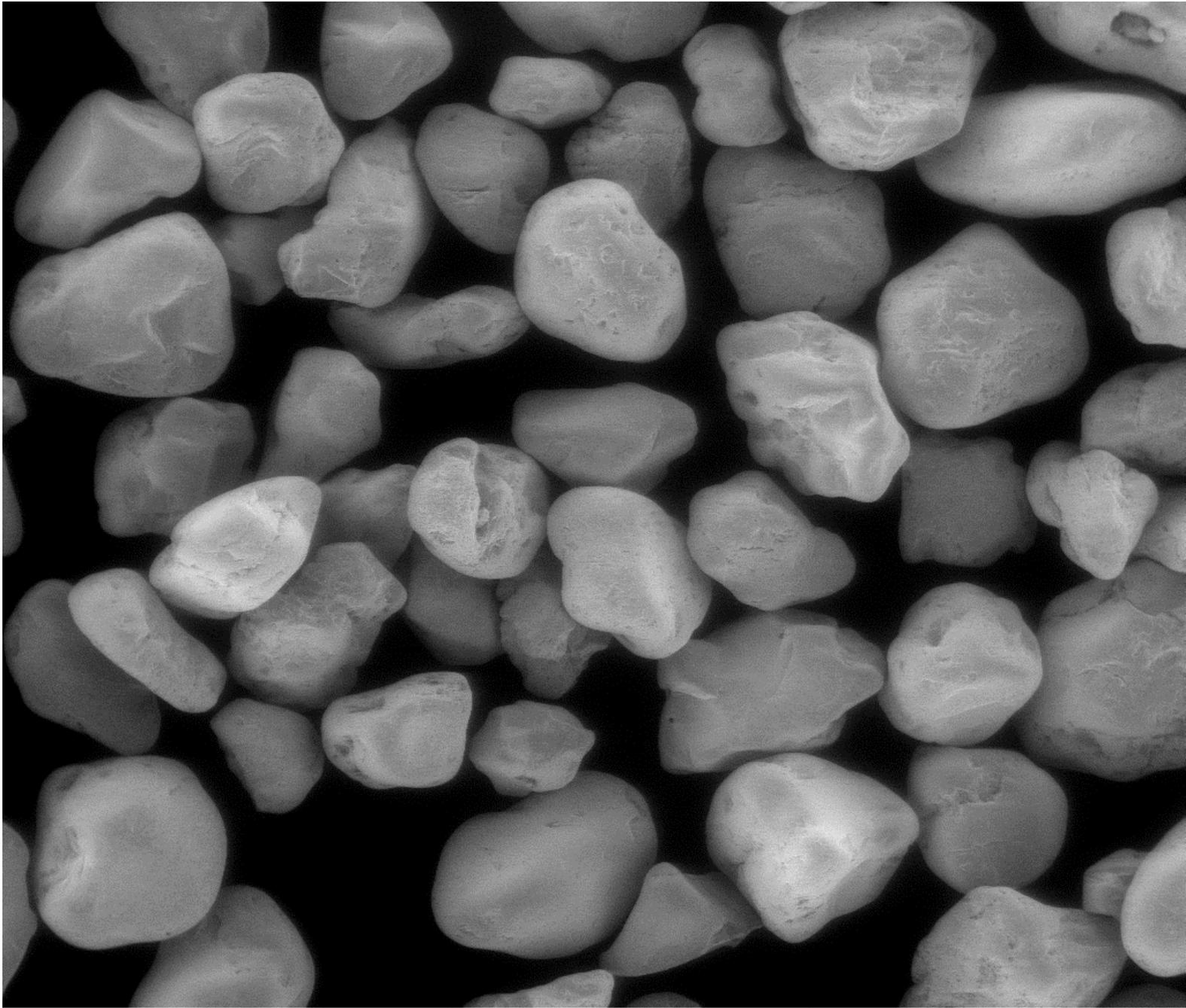


Woburn Sand Formation: Silica sand quarry, Bedfordshire, UK



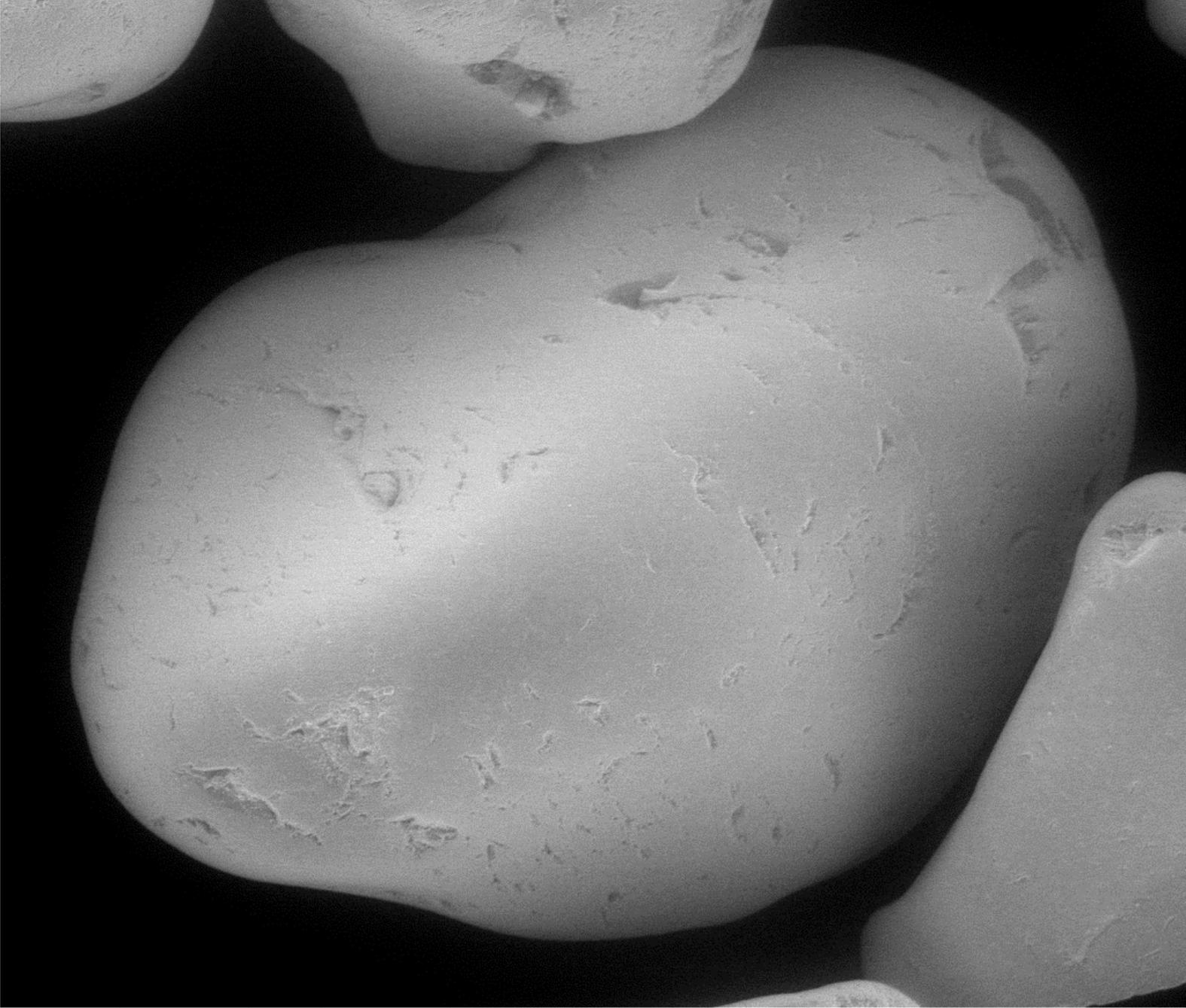
Woburn Sand Formation

2 mm



**Woburn Sand**

curr	HV	det	WD	vacMode	pressure	1 mm
0.49 nA	10.00 kV	LFD	23.6 mm	Low vacuum	8.99e-1 Torr	MPLT615



**Woburn Sand**

curr	HV	det	WD	vacMode	pressure	200 $\mu$ m
0.49 nA	10.00 kV	LFD	23.6 mm	Low vacuum	8.98e-1 Torr	MPLT615

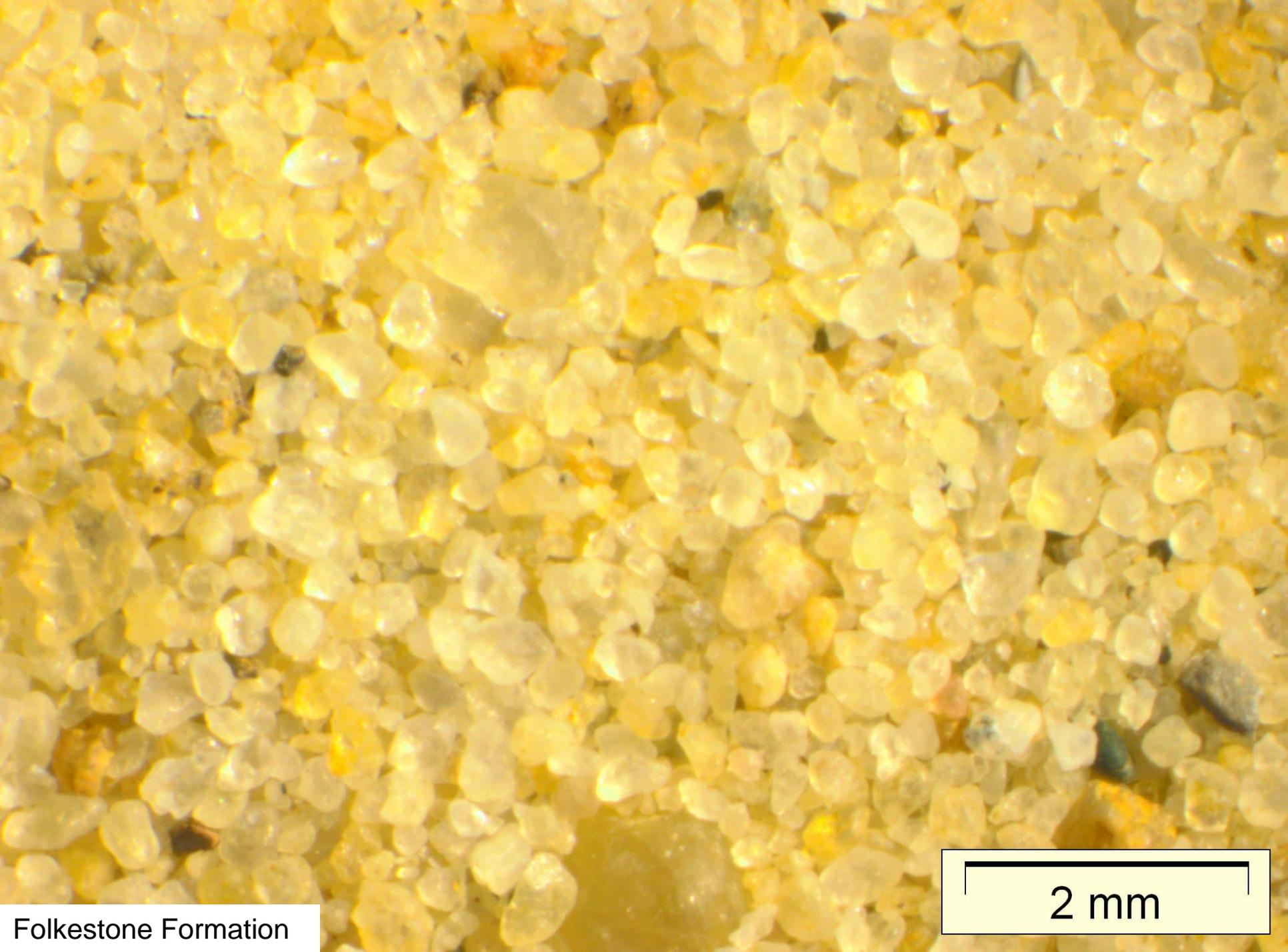




Folkestone Sand Formation: Silica sand quarry, Hampshire, UK

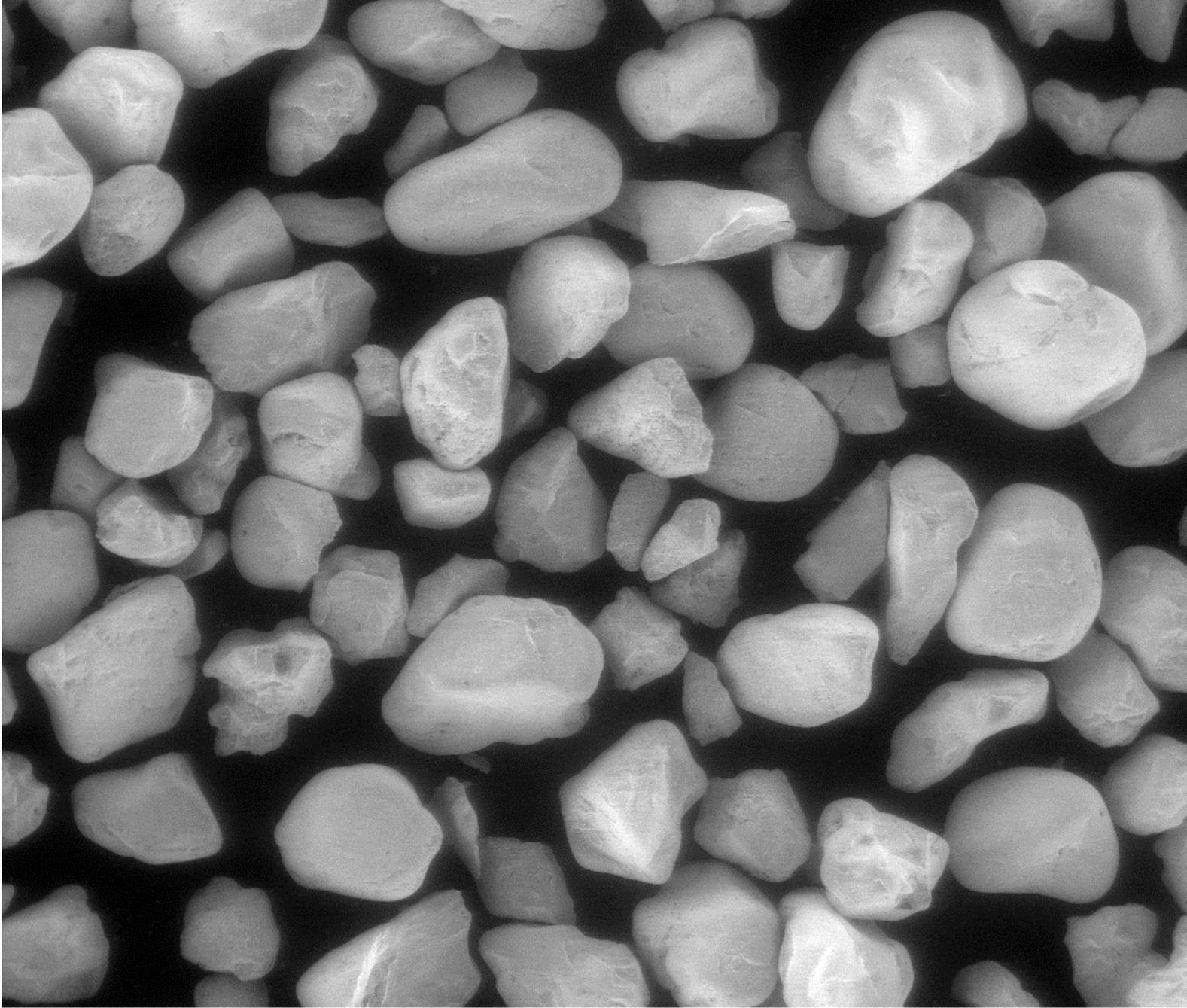


Folkestone Sand Formation: Silica sand quarry, Hampshire, UK



Folkestone Formation

2 mm



**Folkestone  
Sand**

curr	HV	det	WD	vacMode	pressure	1 mm
0.49 nA	10.00 kV	LFD	24.0 mm	Low vacuum	9.02e-1 Torr	MPLT619



**Folkestone  
Sand**

curr	HV	det	WD	vacMode	pressure	200 $\mu$ m
0.49 nA	10.00 kV	LFD	23.8 mm	Low vacuum	9.02e-1 Torr	MPLT619

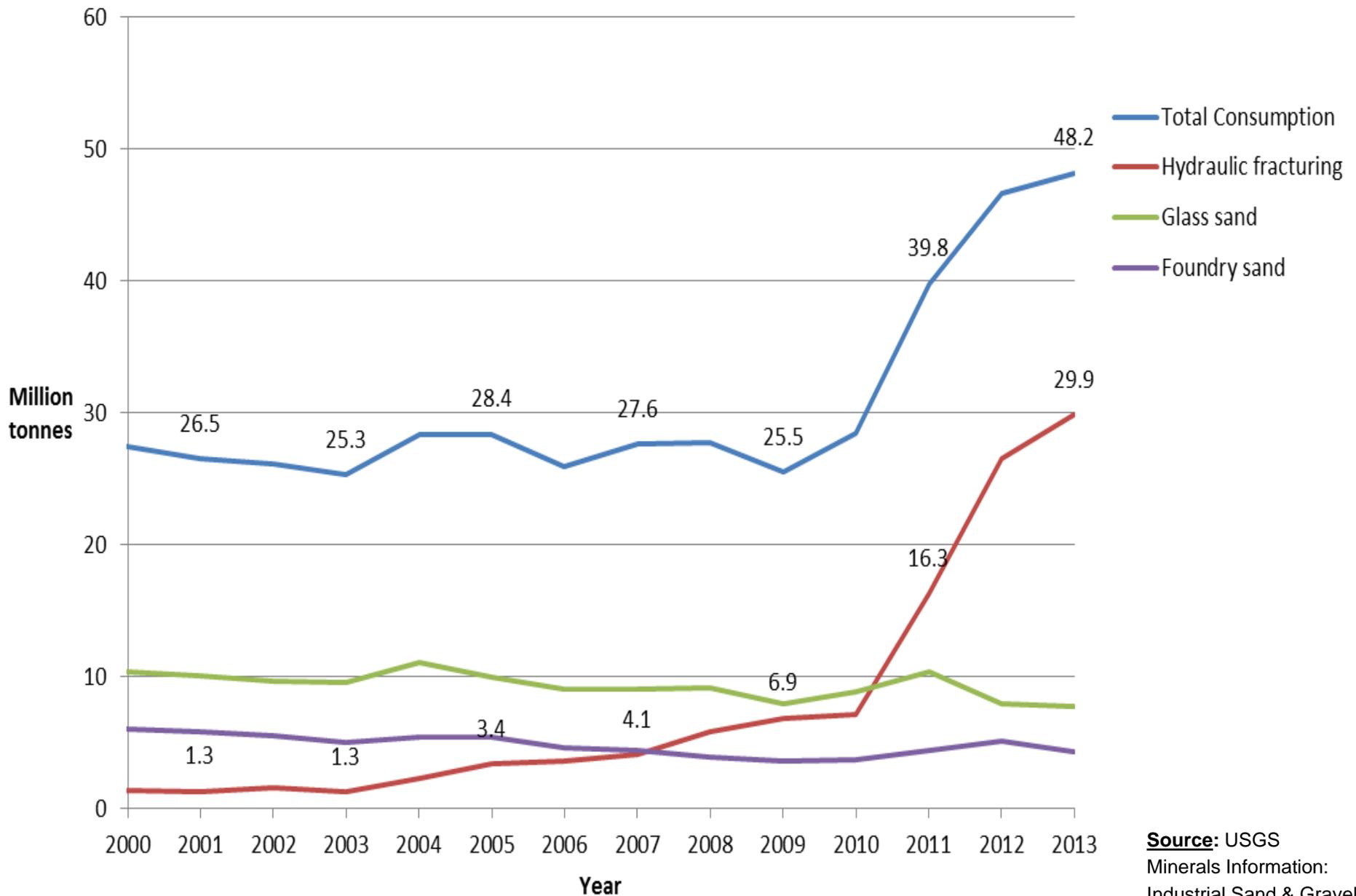


# Future for frac sand?

- Depending on well length/ number of hydraulic fracturing treatments, 2000 to 10,000 tonnes of frac sand per well
- If shale gas is developed in the UK and assuming 10 wells pa, this equals 20,000 to 100,000 tonnes of silica sand (equiv. to 0.5 - 2.5% increase in consumption)
- In the USA, frac sand accounted for 5% (1.4 Mt) of the industrial sand market in 2000, this leapt to 62% (29.9Mt) in 2013\*

\* Sand and gravel (Industrial) U.S.G.S.  
Mineral Commodity Summary 2014

# US Silica Sand consumption 2000-2013



**Source:** USGS  
Minerals Information:  
Industrial Sand & Gravel

# Conclusions

- Frac sand is a potential new application for silica sand in the UK
- There are silica sand deposits in the UK that are potentially suitable for use as frac sand
- Watch this space!



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# Thank you for your attention!



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