INVESTIGATIONS NEAR DEVON GREAT CONSOLS MINE INTO AIRBORNE DUST POLLUTION

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Bruce, J., Fowler, M. and Datson, H. 2013. Investigations near Devon Great Consols Mine into airborne dust pollution. *Geoscience in South-West England*, **13**, 202-207.

An investigation was carried out into whether toxic elements at Devon Great Consols mine and mineral processing site are transferred into airborne dust particles. Deposited dust samples were collected across an area of approximately 15 hectares in the summer of 2011. Soil samples were also collected from within and near the former working areas. Dust sampling took place at locations up to 550 m from the former working areas. Samples were prepared for ICP-MS analysis by strong acid digestion. Crustal enrichment factors (EFs) were determined to compare concentrations in the samples with typical crustal values. EFs for arsenic and copper were very high and showed little significant difference between the soils and the dusts in the source area. EFs appear to reduce beyond the former mine workings. The soil appears to be a principal source for arsenic and copper in the dust particles. On the basis of comparison with findings elsewhere, it is possible that the UK target value for airborne arsenic could have been exceeded significantly. Given that the site is a current public open space, and that the bioavailability of these elements at this site has been recognised by others, there may be grounds for health risk concerns.

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Keywords: Fugitive dust, arsenic, mine spoil, crustal enrichment factor, South-West England.

INTRODUCTION

This paper describes an investigation into whether potentially-toxic elements at the Devon Great Consols mine and mineral processing site have been transferred into airborne dust particles which might have left the site. Devon Great Consols, an old mining site in South-West England, has had a plethora of scientific studies analysing the mine spoils resulting from its extensive extraction in the late 19th Century. Studies have shown very high levels of elements such as arsenic and copper present in the soil and water column (Hamilton, 2000), but no data have been published on the pathway of dust propagation at and around the site. This study therefore aims to use modern dust collection techniques, supplemented by quantitative elemental analysis, to determine if dust in the area can be considered a potential risk to local receptors.

There were three main objectives in the study:

1) To collect a set of dust samples in order to investigate levels of toxic elements present in dust at and around mine spoil sites, assessing the potential link between distance from the contaminated land and toxic element concentrations.

2) To collect soil samples in order to investigate whether elemental levels found in the dust samples can be directly attributed to the former mining activity and the adjacent soils.

3) To compare concentrations of toxic elements found in the dust samples to background levels, and national limit values, in order to highlight potential impacts on local receptors.

BACKGROUND

Devon Great Consols

Devon Great Consols [SX 431 735] is a highly mineralised ex-mining area of 68 hectares (Kavanagh *et al*., 1997) which lies in the parish of Gulworthy, in the county of Devon, approximately 10 miles north of Plymouth. It is immediately west of Dartmoor National Park, and adjacent to the River Tamar, which forms the western boundary of the site. The River Tamar was crucial to the industry that took place, with boats used to transport excavated minerals (Otter, 1994).

The Devon Great Consols site is set within the Tamar Valley, an area underlain by Late Devonian Tavy Formation sediments (Leveridge and Hartley, 2006). The Dartmoor granite pluton was intruded into the surrounding sedimentary rocks in the Early Permian Period, as part of a group of intrusions produced from the Cornubian Batholith (e.g. Watson *et al*., 1984). Hydrothermal processes related to and following the plutonism caused a wide range of minerals to be formed, with fluids depositing their metal ores within and around the edge of the pluton, in locations such as Devon Great Consols (Natural England, 2012).

The mining site that gave its name to Devon Great Consols began extraction in 1844 and quickly established itself as the world's richest copper and arsenic mine (Hamilton, 2000). The underground mine workings were 4 km in length along the main ore vein; up to 1,300 people were employed, and a railway link was established nearby to transport the ore for shipment and handling. The copper mine was slowly depleted and a shift to arsenic and tin production began in 1880. In the