Analyses of the Swedish ancient iron reference slag W-25:R

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ABSTRACT: The increasing importance of chemical analyses for the interpretation of slags found at archaeometallurgical sites has increased the need for a reference material for ancient iron slags. Several sets of analytical data on the Swedish reference slag W-25:R are presented and discussed.

Introduction

Chemical compositions of ancient iron slags derived from bloomery processes are characterized by high iron contents, the presence of metallic iron, variable but generally high manganese contents, and fairly low silica contents. Thus, these compositions are often outside the calibration range of commercial analytical laboratories.

Chemical analyses of ancient slags have increasingly grown in importance for the interpretation of both ores and techniques used (e.g., Kresten et al 1998). Therefore, the need for a reference material has increased. To meet that demand, we now present the first compilation of data on the Swedish ancient iron reference slag W-25:R.

The material

The Viking Age iron production site Gryssen in Dalecarlia has been described by Seming (1973). The site is situated on a small point of land protruding into lake Gryssen, which apparently supplied lake ore for the process. The slags sampled are composed of wustite (93-96% FeO, minor amounts of TiO₂, Al₂O₃, MnO and MgO) and fayalitic olivine (~29% SiO₂, ~66% FeO, ~1.5% MnO, 0.6-1.5% MgO) set in a glassy matrix (38-44% SiO₂, 12-21% FeO, <0.5% MnO, 8-10% CaO, ~4% Na₂O, ~6% K₂O). In addition, occasional droplets of metallic iron occur.

The melting temperature of the homogenized sample was determined by differential thermal analysis (DTA) to be 1115°C. The compositions of co-existing olivine-glass pairs indicate olivine crystallization temperatures in the range 1050-1090°C (for details on the method, see Kresten et al 1998).

Thirty-two kilograms of slag were collected and crushed in a jaw crusher. The crushed sample was split into two parts, A and B, which were each subdivided into four parts, A₁ to A₄, and B₁ to B₄, respectively. Each one of these was ground in a rotating mill with Widia grinding vessels and split into four parts, labelled A₁₁, A₁₂, A₂₁, A₂₂, etc, each of which was divided into six sub-sets, A₁₁₁, A₁₁₆, A₁₂₁, A₁₂₆ etc, weighing about 170g each.

Participating laboratories

The following laboratories have participated:
• VOEST, Linz, Austria. Conventional methods (wet-chemical, atomic absorption).
• Sandvik steel research laboratory, Sandviken, Sweden. Conventional methods (wet-chemical, atomic absorption).
• Studsvik Energiteknik AB, Studsvik, Sweden. Instrumental neutron activation analysis (INAA).
• LKAB Prospektering, Håksberg, Sweden. Inductively coupled plasma spectroscopy (ICP-AES).
• SGAB1, Swedish Geological Company, Luleå, Sweden. Inductively coupled plasma spectroscopy (ICP-AES).
• SGU (Swedish Geological Survey), Uppsala, Sweden. Conventional methods (atomic absorption, titration, gravimetry).