Process Mineralogical Studies of Iranian Titanomagnetite

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ABSTRACT

The Qara-aghaj hard rock titanium deposit is located in the 36 Km at the North-West of Euromieh, Iran. Mineralogical studies performed by XRD, XRF, Optical microscopy and SEM indicated that the ilmenite, magnetite and apatite are main valuable minerals. The gangue minerals consist of the silicate minerals such as pyroxene, olivine, plagioclase and some secondary minerals. The liberation degree was determined 150 microns for ilmenite and magnetite and 60 microns for apatite. Mineralogical studies by optical microscopy and SEM indicated that the ilmenite is mainly of granules form but some lamellae of ilmenite are found inside magnetite. Some narrow lamellae of hematite are formed inside ilmenite. Analyzing by EDX indicated that maximum content of TiO_2 in the ilmenite is 48%. Mn and Mg have been replaced in ilmenite lattice. By analyzing of magnetite, it was found that the V_2O_5 content is up to 1%. V^{3+} is found in magnetite lattices by replacing Fe^{3+}. Analyzing of clinopyroxenes indicated that augite, containing Ti, is the main form of this group. Ilmenite, apatite and magnetite are valuable minerals for production of TiO_2, P_2O_5 and Fe, respectively and the V_2O_5 can be extracted from magnetite as a by-product.

Keywords: Titanomagnetites, Process Mineralogy, ilmenite, magnetite, apatite

INTRODUCTION

Titanium is widely used as titanium dioxide (TiO2) for production of white pigment (Colin J Douch, 2001). Ilmenite (FeTiO3, 52.6% TiO2 and 47.4% FeO) is the most common source of titanium dioxide (Chernet Tegist, 1999). The term ilmenite, as used in the titanium industry, commonly covers the entire range from unweathered ilmenite with TiO2 contents below 50% to altered ilmenite containing more than 60% TiO2 (Chernet Tegist; 1994). All economically exploitable ilmenite occur as hard-rock resources and beach sands. The amenability of various iron-titanium deposits to beneficiation is controlled by mineralogical and textural characteristics. In the evaluation of the mineralization and in the design of procedures of mineral dressing, the distribution of the valuable material is a matter of immediate importance. It is necessary to determine whether a given element is occurring in one mineral or several. Considering the magmatic titanium deposits, the majority of the worlds economic rock deposits of titanium minerals are restricted to massive or disseminated anorthositic or gabbroic rocks. They are classified as ilmenite-magnetite deposits, ilmenite-hematite deposits and ilmenite-rutile deposits (Chernet Tegist; 1994).

The Qara-aghaj hard rock titanium deposit which is studied in this paper is located in the 36 Km at the North-West of Euromieh in Azarbayejan province, Iran (Figure 1). This deposit has been identified as a titanium-phosphorus resource. Based on the geological and petrological studies at the region, the most important rock massif formation that have caused titanium and phosphate mineralization, is the intrusive igneous rocks named as the Qara-aghaj mafic-ultramafic intrusive mass. This mass has formed of three portions: the ultramafic zones have been formed by wherlite and pyroxenite; the mafic zones are compound of the gabbro, gabbro-norite and gabbro-diorite; and the intermediate portion has formed of the diorite, some tonalite and a little quartz-feldspar veins. This formation has chemical properties of the intermediate alkali magma, which have injected into crust rocks and then have caused the magmatic phenomenon and metallization. At the preliminary exploration, some 1590 meters trenches have excavated throughout in the outcrop of the deposit. In addition, four exploration faces and two boreholes with overall length about 155 m have been excavated in this stage. The exploration studies show an estimated reserve of 209 Mt. with an average grade of 8.5% TiO2 (Irannajad, M., 2002, Mehdilo, A., 2003, Irannajad, M., Mehdilo; A., 2004 and Irannajad, M., Mehdilo, A., 2007).

MATERIALS AND METHODS

Four representative samples from exploration faces (F, G, C and H) and two drill core samples from two boreholes (BH1 and BH2) with overall length about 155 m were collected. The head sample was obtained by mixing the six crushed samples (-2 mm) proportionate with their weight in the reserve. The crushing of the samples less than 2 mm was done by laboratory jaw, cone and roller crushers. The rod and ball mills