



Neoproterozoic Cana Brava chrysotile deposit (Goiás, Brazil): Geology and geochemistry of chrysotile vein formation



João Carlos Biondi

UFPR Universidade Federal do Paraná, Department of Geology, C.P. 19.001, 81.531-980 Curitiba, Brazil

ARTICLE INFO

Article history:

Received 20 April 2013

Accepted 20 October 2013

Available online 30 October 2013

Keywords:

Cana Brava (Goiás, Brazil)

Serpentinization

Cross-fiber chrysotile

Oxidation state

ABSTRACT

The Cana Brava chrysotile asbestos deposit of Goiás, Brazil, contains approximately 150 Mt of ore with an average of 3.5 wt.% of cross-fiber chrysotile and lies in the differentiated, mafic–ultramafic Neoproterozoic Cana Brava complex. This complex was formed at approximately 0.79 Ga and metamorphosed at 0.77 to 0.76 and 0.63 Ga. The 0.77 to 0.76 Ga metamorphic event was a high-grade one that transformed the mafic and ultramafic rocks into meta-peridotites and meta-pyroxenites. The low-grade 0.63 Ga metamorphism allowed the formation of black, red and brown serpentinite, graphitic, magnesite-rich talc serpentinite, and rodingite, which became folded and foliated. At the end of the 0.63 Ga metamorphism, black serpentinites were oxidized to form red serpentinites, the main type of serpentinite that outcrops today at the Cana Brava mineralized region. Post-metamorphic fluids reactivated the process of serpentinization, thereby generating massive green serpentinite from the red. Green formed on the most fractured zones, and double red and green reaction rims formed on the sides of the veins located outside the green serpentinite zones. This process did not cause significant variation in the volume of the rocks and resulted in a strongly reducing system thanks to the loss of Fe_2O_3 and iron and the subsequent crystallization of magnetite within veinlets and altered rocks. Low angle shear, developed under brittle conditions, caused hydraulic fracturing and the generation of oversaturated, oxidizing fluids that crystallized the cross-fiber chrysotile inside open fractures. Very densely fractured zones with fractures filled with cross-fiber chrysotile constitute the ore that is mined at present.

© 2013 Elsevier B.V. All rights reserved.

1. Introduction

The Cana Brava cross-fiber chrysotile deposit is hosted in the ultramafic unit of the Cana Brava Neoproterozoic mafic–ultramafic complex located 500 km to the north of Brasília, Brazil (Fig. 1A). The deposit was discovered in 1960, and mining began in 1966. In 2009, based on the description of 865 drill holes, it was estimated that Cana Brava originally contained approximately 150 Mt of ore with an average of 3.5 wt.% of cross-fiber chrysotile. The mine is owned by Sociedade Anônima Mineração de Asbestos (SAMA) and is the largest deposit and the largest chrysotile mine in South America.

The aim of the present study is to contribute to the understanding of (a) the formation processes of the cross-fiber chrysotile deposit, which is characterized by a large volume of rock with high economic concentrations of cross-fiber chrysotile-filled veins; (b) the genesis of the cross-fiber chrysotile veins; (c) the serpentinite reaction rims developed at the sides of the cross-fiber chrysotile veins; and (d) the reasons for the colors of the black, red, brown, and massive green serpentinites occurring at Cana Brava. These processes are discussed in relation to the chemical and volumetric changes of the rock, the mass balance of the

processes, the physical changes related to serpentinization, and the changes in oxidation state that occurred during serpentinization.

1.1. Sampling and analytical methods

The samples used in the present study were obtained from 103 outcrops, collected during mapping of both the pits and of the regional geology. The petrographical and mineralogical characteristics of the meta-ultramafic rocks were determined by microscopic investigation of 120 thin sections. To distinguish among the serpentinite mineralogy, 38 of the optically characterized samples were also analyzed using X-ray diffraction (XRD). XRD was performed at LAMIR—Paraná Federal University Laboratory, using a PANalytical Empyrean X-ray diffractometer, with a 2θ range of $1\text{--}70^\circ$, a temperature of 25.0°C , a voltage of 60 kV and a current of 40 mA. Selected samples were crushed in tungsten carbide mills and separated into four 200 g aliquots prior to the analysis of major and trace elements at Acme Analytical Laboratories Ltd., Vancouver, Canada. Rare earth element (REE) abundances were measured using inductively coupled plasma mass spectrometry (ICP-MS), elements and oxides were detected using inductively coupled plasma emission spectroscopy (ICP-OES), and the FeO content was determined using the standard titration method. Reproducibility was measured using six duplicate samples, and the variability was on

E-mail address: biondiufpr@gmail.com.

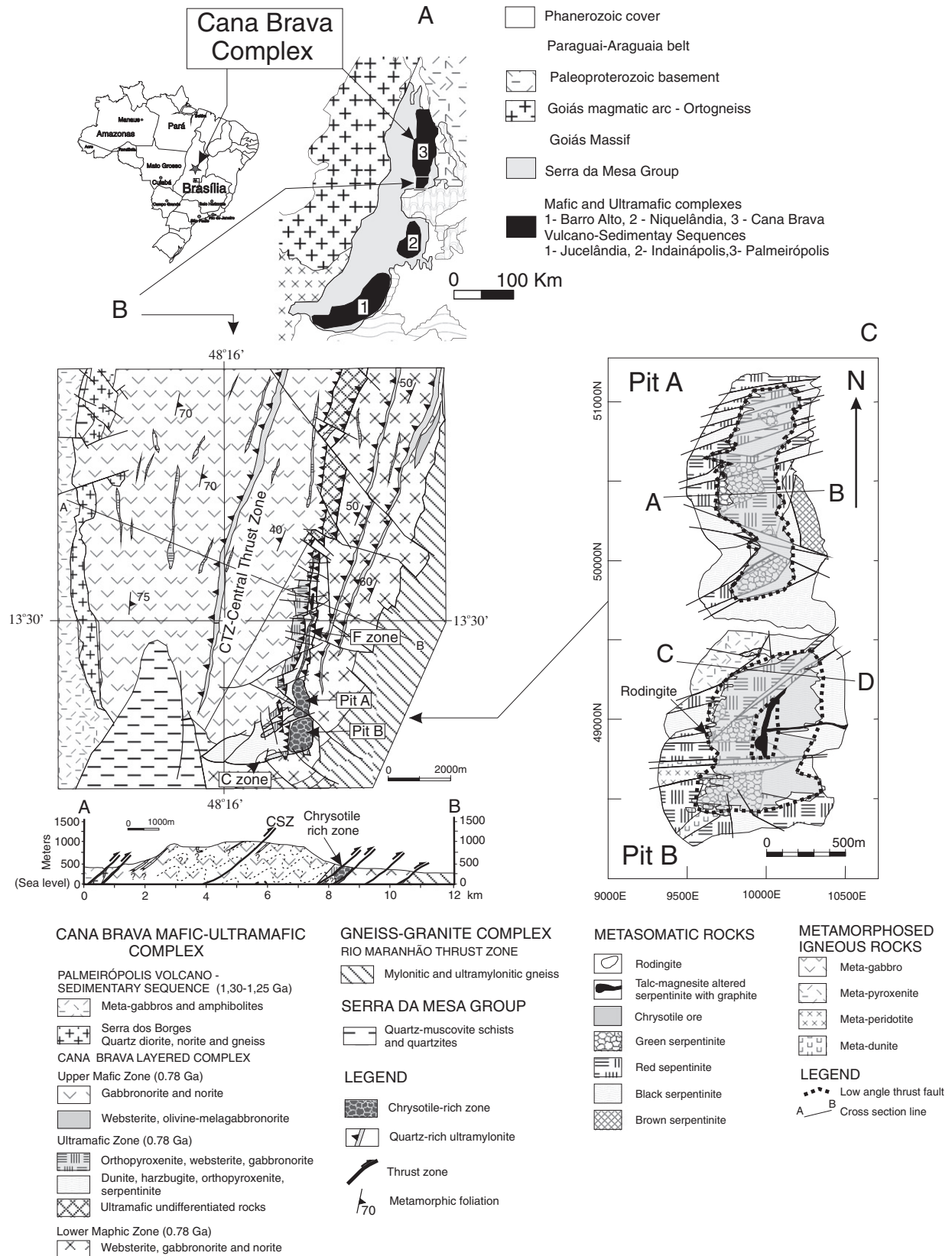


Fig. 1. (A) Geological setting of the Cana Brava complex (Minaçu, GO, Brazil). (B) Geological map of the Cana Brava deposit region in the southern part of the Cana Brava complex. (C) Geological map of pits A and B of the Cana Brava chrysotile mine. The locations of the cross-sections in the location of cross sections in Fig. 2.

average 5% for all elements. The rock standards STD SO-18, STD CSC, STD OREAS76A, STD DS7 and STD OREAS45PA were used to monitor accuracy, and our results were within 5–10% of these values on average.

To measure the densities of the rock samples, each one was weighed, and its volume was measured using an Archimedes balance, which determined the volume by measuring the buoyant force exerted on the

Download English Version:

<https://daneshyari.com/en/article/4716125>

Download Persian Version:

<https://daneshyari.com/article/4716125>

[Daneshyari.com](https://daneshyari.com)