Césarferreiraite, Fe$^{2+}$Fe$^{3+}$(AsO$_4$)$_2$(OH)$_2$·8H$_2$O, from Eduardo mine, Conselheiro Pena, Minas Gerais, Brazil: Second arsenate in the laueite mineral group

Ricardo Scholz$^{1,4}$, Nikita V. Chukano$^{2}$, Luiz A.D. Menezes Filho$^{3}$, Daniel Atencio$^{4}$, Leonardo Lagoeiro$^{1}$, Fernanda M. Belotti$^{5}$, Mário L.S.C. Chaves$^{6}$, Antônio W. Romano$^{3}$, Paulo R. Brandão$^{6}$, Dmitriy I. Belakovskiy$^{7}$ and Igor Pekov$^{8}$

$^1$Escola de Minas, Departamento de Geologia, Universidade Federal de Ouro Preto (UFOP), Campus Morro do Cruzeiro, 35400-000, Ouro Preto, Minas Gerais, Brazil
$^2$Institute of Problems of Chemical Physics, Russian Academy of Sciences, Chernogolovka, Moscow region, 142432, Russia
$^3$Instituto de Geociências, Universidade Federal de Minas Gerais, Av. Antônio Carlos, 6627, 31270-901, Belo Horizonte, Minas Gerais, Brazil
$^4$Instituto de Geociências, Universidade de São Paulo, Rua do Lago, 562, 05508-080, São Paulo, SP, Brazil
$^5$Universidade Federal de Iaújuba (UNIFEI), Campus Iaújuba, Iaújuba, Minas Gerais, Brazil
$^6$Escola de Engenharia, Universidade Federal de Minas Gerais, Av. Antônio Carlos, 6627, 31270-901, Belo Horizonte, Minas Gerais, Brazil
$^7$Fersman Mineralogical Museum of the Russian Academy of Sciences, Leninsky Prospekt 8-2, 117071 Moscow, Russia
$^8$Faculty of Geology, Moscow State University, V orobievy Gory, 119899 Moscow, Russia

ABSTRACT

Césarferreiraite, Fe$^{2+}$Fe$^{3+}$(AsO$_4$)$_2$(OH)$_2$·8H$_2$O, is a new laueite-group mineral (IMA 2012-099) of triclinic symmetry, from Eduardo pegmatite mine, Conselheiro Pena municipality, Minas Gerais, Brazil. Intimately associated minerals are pharmacosiderite, scorodite, and earlier arsenopyrite, and probably césarferreiraite replaces the latter. It occurs as fibrous-to-tabular aggregates up to 2 mm. Single crystals, up to 10 mm long with a thickness of about 1–2 mm, are elongated along [001] and flattened on (100). The fibers have almost rectangular cross-section apparently bound by the {100} and {010} pinacoid forms. Color and streak are pale to greenish yellow. Luster is vitreous; individual crystals are transparent and masses are translucent. Cleavage is distinct, presumably on {010} and {100}. Calculated density is 2.934 g/cm$^3$. The mineral is biaxial (+), $n$ (min) = 1.747(3), $n$ (max) = 1.754(3) (589 nm). IR spectrum of césarferreiraite is unique and can be used for the identification of the mineral. Chemical composition (n = 4, WDS, calculated for the condition Fe$^{3+}$.Fe$^{2+}$:Fe$^{3+}$ = 1:2, H$_2$O for the ideal structural formula, wt%) is: FeO 11.50, FeO 25.56, CaO 15.41, As$_2$O$_5$ 33.51, H$_2$O 26.01, total 100.12. The empirical formula (based on 18 O apfu) is Fe$_{6.99}^{2+}$.Fe$_{1.96}^{3+}$(AsO$_4$)$_{1.75}$(PO$_4$)$_{0.33}$(OH)$_{1.85}$.8.08H$_2$O. The strongest eight X-ray powder-diffraction lines [20 $F$ $(hkl)$] are: 9.85(95)(010), 6.35(100)(001), 3.671(29)(T21), 3.158(32)(T10), 2.960(39)(022), 2.884(35)(T31), 2.680(29)(2T11), and 2.540(23)(2T10). Unit-cell parameters refined from powder data indexed by analogy with related laueite-group minerals (space group: $P1$) are: $a = 5.383(2)$ Å, $b = 10.563(3)$ Å, $c = 6.878(2)$ Å, $\alpha = 96.42(4)^\circ$, $\beta = 109.19(3)^\circ$, $\gamma = 102.30(2)^\circ$, $V = 347.1(2)$ Å$^3$, and $Z = 1$. Gladstone-Dale compatibility is $-0.020$ (excellent). Césarferreiraite is the arsenate analog of ferrolaueite.

Keywords: Césarferreiraite, new mineral, granitic pegmatite, Conselheiro Pena, Minas Gerais, Brazil, laueite group, iron arsenate

INTRODUCTION

In May 2009, during the preparation of the Eastern Brazil Pegmatite field trip for the 4th International Symposium on Granitic Pegmatites (PEGM 2009), two of the authors (R.S. and A.W.R.) found a centimetric cavity covered by pharmacosiderite and an unusual yellowish fibrous aggregate. The latter turned out to be a new mineral species belonging to the laueite group, with the formula Fe$^{2+}$Fe$^{3+}$(AsO$_4$)$_2$(OH)$_2$·8H$_2$O. It was approved by the IMA CNMNC on March 1, 2013, with the name césarferreiraite (IMA 2012-099).

The name is in honor of César Mendonça Ferreira (b. 1942). Graduating as a Geology Engineer in the School of Mines of Ouro Preto in 1970, Ferreira developed a long career as Professor in Mineralogy and Gemology. He engaged in many studies of the mineralogy of ores and in the field of geometallurgy. During the last 15 years, he was responsible for establishing the Gemological Laboratory of the Federal University of Ouro Preto. Professor Ferreira has agreed to the naming of the mineral. The holotype has been deposited in the mineralogical collection of the Museum of Ciência e Técnica, Escola de Minas, Universidade Federal de Ouro Preto, Praça Tiradentes, Centro, 35400-000—Ouro Preto, Minas Gerais, Brazil, registration number SAA-011.

GEOLoGICAL SETTING AND OCCURRENCE

Césarferreiraite occurs in a 1 cm$^3$ miarolitic cavity in albite in the Eduardo pegmatite mine (“Lavra do Eduardo,” in Portuguese), near Boa Vista creek, Conselheiro Pena municipality, Minas Gerais, Brazil (19°4′53.09″S 41°30′34.10″W), in associa-