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# Spriggite, $Pb_3[(UO_2)_6O_8(OH)_2](H_2O)_3$, a new mineral with β-$U_3O_8$–type sheets: Description and crystal structure

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## ABSTRACT

Spriggite, $Pb_3[(UO_2)_6O_8(OH)_2](H_2O)_3$, is a new hydrated Pb uranyl oxyhydroxide found near Arkaroola, Northern Flinders Ranges, South Australia. The new mineral's name honors geologist and conservationist Reginald Claude Sprigg (1919–1994), founder of the Arkaroola Tourist Station. Together with beta-uranophane, soddyite, kasolite, Ce-rich francoisite-(Nd), metatorbernite, billietite, Ba-bearing boltwoodite, schoepite, metaschoepite, and weeksite, spriggite results from the supergene alteration of U-Nb-REE-bearing hydrothermal hematite breccia. Spriggite forms prismatic crystals up to about 150 μm in length and up to 40 μm across. It is transparent, bright orange in color with vitreous luster, biaxial, $n_{min}$= 1.807; $n_{max}$ = 1.891 ($Na_D$, 22.5 °C), non-fluorescent, brittle with an uneven fracture. It has a pale orange streak, Mohs' hardness ~4, good cleavage along (100) and $D_{calc}$ = 7.64(6) g/cm$^3$. The empirical formula is $(Pb_{2.77}Ca_{0.06}Ba_{0.04})_{\Sigma 2.87}U_6O_{19.9}(OH)_2 \cdot 3H_2O$, and the simplified formula is $Pb_3[(UO_2)_6O_8(OH)_2](H_2O)_3$. Spriggite is monoclinic, *C*2/*c*, *a* = 28.355(9), *b* = 11.990(4), *c* = 13.998(4) Å, β = 104.248(5); *V* = 4613(3) Å$^3$, *Z* = 8. The strongest eight lines in the powder X-ray diffraction pattern are [*d* in Å (*I*)(*hkl*)]: 6.92(60)(400), 6.02(30)(11$\bar{2}$;020), 3.46(80)(800), 3.10(100)(204;$\bar{6}$04;3$\bar{3}$2;$\bar{5}$32), $\bar{2}$.74(30)($\bar{4}$40), 2.01(30)(33$\bar{6}$), 1.918(60)(10.0$\bar{4}$;14.0$\bar{4}$;11.$\bar{3}$2;$\bar{1}\bar{3}$.31), 1.738(30)(5$\bar{3}$6;$\bar{1}\bar{1}$.36). The structure has been solved from a crystal twinned on (001) and refined to R1 = 9.7%. The structure is based upon the $[(UO_2)_6O_8(OH)_2]^{6+}$ sheets of uranyl polyhedra of the β-$U_3O_8$ anion topology with $Pb^{2+}$ cations and $H_2O$ groups in the interlayer. Billietite and spriggite contain only hexavalent U in the uranyl sheets, whereas the similar sheets in β-$U_3O_8$ contain $U^{5+}$ and $U^{6+}$, and those in ianthinite $U^{4+}$ and $U^{6+}$. Spriggite has the highest Pb:U ratio among the known hydrated Pb uranyl oxyhydroxide minerals.