

Coupling Ni and S isotopes to disentangle the geochemical reactions underpinning the impact of wildfires on nickel dynamics in ultramafic wetlands of New Caledonia

Gael Thery¹, Cécile Quantin², Damien Calmels³, Julie Jeanpert⁴, Christophe Cloquet⁵, Gael Monvoisin⁶, Guillaume Paris⁷, Guillaume Morin⁸, Emmanuelle Montarges-Pelletier⁹, Pierre Genthon¹⁰ and Farid Juillot¹¹

¹GEOPS, Université Paris-Saclay, CNRS, France

²GEOPS, Université Paris Saclay, CNRS

³GEOPS, Université Paris Saclay (UMR 8148)

⁴Agence de l'eau Rhône Méditerranée Corse

⁵CRPG – CNRS, Université de Lorraine

⁶Université Paris-Saclay, CNRS, GEOPS

⁷Université de Lorraine, CNRS, CRPG

⁸Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie (IMPMC), UMR 7590 Sorbonne Université-CNRS-MNHN-IRD

⁹Université de Lorraine, CNRS, LIEC

¹⁰IRD

¹¹ERL IRD 206, UMR 7590 CNRS-MNHN-Sorbonne Université

Over 30% of continental land surfaces are affected by wildfires, which spread over ~6.5 million km² each year [1,2]. These fires have devastated vast wetland surfaces, particularly in connection with recurring droughts. Wildfires and droughts are strongly influenced by natural climatic phenomena such as El-Niño, and their frequency and intensity are increasing due to current climate change [3,4]. In addition to their devastating impact on biodiversity, wildfires represent a real threat to the quality of water resources, as they can lead to contamination by trace metals (TM)[5].

In New Caledonia, soils developed on the Peridotite Nappe are naturally enriched in TM, such as nickel, and around 300 km² (2% of the territory) of vegetation burn annually on the archipelago [6]. Following a fire in November 2019, nickel contamination was observed in a drinking water supply catchment at Ile des Pins (south of the archipelago). Nickel concentrations reached 4,000 µg/L (WHO standard 70 µg/L) in this catchment, fed by a dolines and sinkholes system.

It has been shown elsewhere that fires and piezometric variations in wetlands, comparable to doline and sinkhole systems in New Caledonia, can disrupt the biogeochemical cycles of sulfur and TM [7,8]. Following the 2019 fire, geochemical analyses of the water in these sinkholes showed strong acidification (pH~3) associated with high Ni and SO₄ concentrations (i.e., up to 370,000 µg/L and 3200 mg/L, respectively). Coupling Ni and S isotopes across the catchment enabled us to determine the geochemical reactions that are at the

origin of this contamination and that control Ni and S dynamics from the doline to the water supply.

Beyond the single case of New Caledonia, the results obtained bring original information on the geochemical pathways that wildfires can induce on nickel dynamics at ultramafic geological settings worldwide.

[1] Chuvieco et al., 2018, <https://doi.org/10.5194/essd-10-2015-2018>, [2] Giglio et al., 2010, <https://doi.org/10.5194/bg-7-1171-2010>, [3] Wang and Cai., 2020, <https://doi.org/10.1186/s40562-020-00168-2>, [4] Goss et al., 2020, <https://doi.org/10.1088/1748-9326/ab83a7>, [5] Abraham et al., 2017, <https://doi.org/10.1016/j.scitotenv.2017.05.096>, [6] Dumas et al., 2013, <https://doi.org/10.4000/rge.4598>, [7] Blake et al., 2021, <https://doi.org/10.1007/s11270-021-05013-6>, [8] Mosley et., 2014, <https://doi.org/10.1016/j.jhydrol.2014.02.001>