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Effects of pyrogenic carbon and fire characteristics on its consumption in subsequent fires

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Pyrogenic carbon (PyC) represents one of the most degradation-resistant organic carbon pools in the Earth, but its long-term fate and the processes leading to its degradation remain subject of debate. A frequently highlighted potential degradation mechanism of PyC is the consumption of PyC in subsequent fires, however, the effects of PyC chemical characteristics and fire conditions on this process remain unexplored. To address this, we placed four materials with different degrees of thermal and chemical recalcitrance (wildfire charcoal, slash-pile charcoal, pine wood and cedar wood) on the forest floor surface and exposed them to a high-intensity and a low-intensity boreal wildfire.

Mass losses were highly variable and dependent not only on fire, but also sample characteristics. Mass loss correlated significantly with maximum temperature (Tmax) recorded on sample surfaces using thermocouples, but only weakly with time >300 [U+F0B0] C. Mass losses also showed a significant negative correlation with thermal recalcitrance (T50, determined using differential scanning calorimetry) and Tmax with charcoal reflectance (Ro) after the fires. PyC losses in the high-intensity fire were significantly higher than in the low-intensity fire. These results demonstrate that fire can indeed be an important removal mechanism for PyC that remains exposed to subsequent fires. Our data also demonstrate for real wildfire conditions, the (i) contrasting resistance of different PyC types to combustion, and (ii) contrasting net PyC losses between different fire intensities.