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Temporal evolution of wildfire ash and its implications for water pollution

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Ash, the burnt residue generated from combustion of vegetation, litter and surface soil, covers the ground after every wildfire. The effects of wildfire ash on the post-fire landscape are many and very diverse. It is a source of nutrients and can, therefore, help the recovery of vegetation after fire. Furthermore, in its initial state, the ash layer on the ground can protect the bare soil from rain splash erosion and can act as an adsorbent layer, preventing or delaying post-fire water erosion by runoff. However, when the adsorbent capability of the ash layer is exceeded, this highly erodible material can be transported into the hydrological network and be a major contributor to water contamination.

Most previous studies on post-fire erosion and water contamination have focused on soil erosion and associated sediment transfer and overlooked the ash component or, when considered, ash has been included as an unidentified part of the eroded sediment. One of the reasons for overlooking this key post-fire component is the difficulty of ash sampling before it is lost by wind or water erosion or altered by aging on-site.

Here we compare the water contamination potential of ash obtained from two fires in the dry eucalyptus forest environment of the Sydney tablelands, Australia: i) 'aged ash' produced during the severe Balmoral wildfire and sampled two months after the event (Jan. 2014) and ii) 'fresh ash' sampled immediately after a high-intensity experimental fire in the same region (Sept. 2014). At the time of sampling, neither of the ash types had been affected by water erosion, however, the aged ash had been subjected to rainfall events and, potentially, to wind erosion during the two months of exposure. Vegetation type, fuel loads and fire severity, determined using remote sensing and on-site observations, were comparable between both areas sampled.

Ash physicochemical properties differed, with 'fresh ash' having higher pH and EC values and higher concentration of soluble major and trace elements. 'Aged ash' was richer in soil-derived elements (Al, Si and Fe) and exhibited higher bulk density and a lower rainfall storage capacity. We will discuss the similarities and differences between 'fresh' and 'aged' ash properties and identify the potential main threats to water quality derived from each of them.

The water contamination potential from wildfire ash varies depending, among other factors, on the time between the production and transport of the ash into the hydrological system. Therefore, to evaluate the threat of wildfire ash to water quality, not only its intrinsic characteristics, but also its temporal evolution in conjunction with the probability of ash erosion to occur at a given time, need to be evaluated. These additional parameters highlight the complexity of the interaction of many different factors in the post-fire landscape.