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The role of major forest fires on rock physical decay in a Mediterranean environment

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Massive destruction of carbonate rocks occurred on the slopes of Mt. Carmel (Israel), during a severe forest fire in 2010. The bedrock surfaces exhibited extensive exfoliation into flakes and spalls covering up to 80%–100% of the exposed rocks; detached boulders were totally fractured or disintegrated. The fire affected six carbonate units—various types of chalk, limestone, and dolomite. The burned flakes show a consistent tendency towards flatness, in all lithologies, as 85%–95% of the flakes were detached in the form of blades, plates, and slabs.

The extent of the physical disruption depends on rock composition: the most severe response was found in the chalk formations which are covered by calcrete (Nari crusts). These rocks reacted by extreme exfoliation, at an average depth of 7.7 to 9.6 cm and a maximum depth of 20 cm. Scorched and blackened faces under the upper layer of spalls provide strong evidence that chalk breakdown took place at an early stage of the fire.

The extreme response of the chalks can be explained by the laminar structure of the Nari, which served as planes of weakness for the rock destruction. Three years after the fire, the rocks continue to exfoliate and break down internally. As the harder surface of the Nari was removed, the more brittle underlying chalk is exposed to erosion. These flakes seem to play an important role in reforming the soil after the fire, especially by increasing the coarse particles percentage. These, in spite of the absence of vegetation cover, improve soil infiltration and percolation rates and cause long-term changes to the hydrological regime.

It is difficult to estimate the frequency of high-intensity fires in the Carmel region over the past 2-3 million years, as well as the extension and density of the vegetation. It is even harder to assess the frequency of fires (and the destruction) of a single rock outcrop. Our findings show that rock outcrop may lose even 20 cm of its thickness in a single fire. This value, if accounted to the long run, can be responsible for a high percentage of the total denudation rate and therefore, in the mountainous carbonate slopes of the Mediterranean region, wildland fires may serve as extremely important factors in landscape evolution (Shtober-Zisu et al., 2015).

Shtober-Zisu, N., Tessler, N., Tsatskin, A., & Greenbaum, N. (2015). Accelerated weathering of carbonate rocks following the 2010 wildfire on Mount Carmel, Israel. International Journal of Wildland Fire, 24(8): 1154-1167.