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Influence of Wildfire on Earth Surface Processes and Geomorphology

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Wildfire is a global phenomenon that is expected to increase in extent and severity due to shifting land management practices and climate change. It removes vegetation, deposits ash, influences water-repellent soil formation, and physically weathers rock. These changes typically lead to increased erosion through sheetwash, rilling, rock spalling, and dry ravel, as well as increased mass movement in the form of floods, debris flows, rockfall, and landslides. Post-wildfire changes in these processes bring about landform changes as hillslopes are lowered and stream channels aggrade or incise at increased rates. Research has documented increases in erosion after wildfire ranging from 2-1000 times the pre-fire rates. Post-wildfire landscape lowering by erosion has been measured in the western U.S. at magnitudes of 2 mm per year, with sediment delivery at the mouths of canyons increased in the range of 160-1000% during the post-wildfire window of disturbance. Furthermore, post-wildfire sediment transport enhances the development of alluvial fans, debris fans, and talus cones. Debris-flow likelihood is increased following wildfire, such that modest rainstorms with <2 year recurrence intervals are typically sufficient to trigger debris flows with volumes much larger (270-540%) than at unburned sites. In the western U.S., as much as 25-50% of alluvial fan accumulation can be attributed to post-wildfire debris flows and other post-wildfire fluvial transport. The window of disturbance to the landscape caused by wildfire is typically on the order of three to four years, with some effects persisting up to 30 years. Consequently, wildfire is an important agent of geomorphic change.