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Surface vitrification caused by natural fires in Late Pleistocene wetlands of the Atacama Desert

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Melted rocks are a common feature in many of the 175 recognized terrestrial impact structures [1]. However, some glasses, like the Dakhleh Glass [2] or the Edeowie Glass [3] are also attributed to impacts despite the lack of other direct evidence. These cases have been attributed to low-altitude airbursts of cosmic bodies (asteroids, comets) during their entry in the Earth's atmosphere but the identification and mechanism of formation of these glasses are however debated.
Massive glass blocks were recently discovered [4] in the Tamarugal-Llamara basin of the Atacama desert in Chile. We show that these glasses, found near the town of Pica at four localities separated by up to 70 km, are neither fulgurites, nor volcanic glasses, nor metallurgical slags related to anthropic activity, but show close similarities with other glasses, which have been attributed to large airbursts. However, most glasses contain numerous plant imprints and some glasses are mainly made of partially melted silicified plant twigs and field observations indicate that the glasses are restricted to specific Late Pleistocene wetlands. Large oases did indeed form in the hyperarid Atacama desert due to elevated groundwater discharge and increased recharge during the Central Andean Pluvial Event (roughly coeval with the Mystery interval and Younger Dryas). 14C dating and paleomagnetic data indicate that the glasses were formed during at least two distinct periods. The strong environmental control on the distribution of the glasses and large differences in ages rule out the hypothesis of a single large airburst as the cause of surface melting. The available data suggest that the Atacama desert surface glasses were formed in situ by natural fires in soils rich in dry organic matter and siliceous biological remains, at a time of strong climate oscillations between wet (organic matter accumulation in soils) and dry periods (triggering fires) in desert wetlands.
Our interpretation likely applies to other cases of silicate glasses attributed to airbursts, challenging the high airburst rate as well as the interpretation of fossils and organic matter in "impact glasses" [5]. Our study also demonstrates that exotic mineralogy with glass containing spherules of iron sulphides, metallic iron or iron phosphides may not necessarily imply an impact origin. This in turn cast doubts on some studies relating impact and climate change triggering the Younger Dryas cold event at the end of the Pleistocene [6].
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