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Microscale characterisation of damage evolution in curling stones used in international competition

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The rocks used to produce curling stones for international competition are only sourced from two localities in the world: Ailsa Craig, Scotland and Trefor, Wales. Curling stones consist of two components: (1) the running band (the ring-shaped bottom surface of the stone which rests on the ice) and (2) the striking band (the convex band on the profile of stones which collides with those of other stones). With a focus on the striking bands, we aim to document the damage evolution of curling stones using synchrotron microtomography (3D characterisation of pristine samples and 4D damage evolution), optical and scanning electron microscopy (quantitative characterisation of pristine samples and microfracture characterisation of damaged striking bands), and petrophysical testing (fracture characteristics and comparative data). These data will be complemented by an on-ice experiment that will determine the mechanics (e.g., stress distribution, contact area, and velocity) of curling stone impacts. Out of four curling stone varieties (from Ailsa Craig and Trefor), we observe the striking bands of three varieties to show macroscopic, incipient to mature, curvilinear fractures. The curvature of these fractures is consistent and does not vary significantly between individual stones and between curling stone varieties. However, the degree of macroscopic fracture development differs between aged striking bands of curling stone types: Blue Trefor (macroscopic fractures not observed), Red Trefor (weakly incipient), Ailsa Craig Common Green (incipient to juvenile), and Ailsa Craig Blue Hone (juvenile to mature). Unfortunately, it is not possible to determine the degree of usage (age) of the selected samples and thus it is not possible to normalize these apparent differences in damage. Given that the striking band limits the lifetime of curling stones, understanding the damage evolution of curling stones can contribute valuable information to the maintenance of curling stones. The rock physics of curling stone impacts is linked to dynamic spalling and more broadly to rock failure, as these processes are ultimately related to the initiation and propagation of fractures.