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Comparing the long-term fate of a snow cave and a rigid container buried at Dome C, Antarctica

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Ice Memory is an international project aiming at creating a global ice archive sanctuary in Antarctica. The design of a perennial subsurface storage space for the cores is a cornerstone of this project. Here, we use an ice/firn flow model to investigate possible storage solutions that would meet the specific requirements of the project. To this end, we consider two extreme cases in terms of rigidity of the facility: an ice cave dug into the firn and a perfectly rigid container buried within it. We focus on the rate of sinking of the facility as well as on the rate of closure of the cave and the evolution of the normal stresses supported by the container. Our results show that the lifetime of a cave is highly affected by the initial density of snow in its surrounding. On the other hand, the presence of the rigid container within the domain perturbs the flow of snow, creating patches of high density in its surrounding and leading to significant normal stresses on its walls. In particular, strong stress concentrations are obtained at the container angles. These results prove that unreinforced shipping containers are unsuited for this task.