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Designing a framework for the durable storage of stable carbonate minerals - storage system design and reversal risk considerations

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The growing need to mitigate climate change and meet climate goals has spurred the development of carbon dioxide removal (CDR) technologies. Many of these technologies store removed CO_2 through the formation of stable carbonate minerals as a means of long-term carbon storage. We present a comprehensive framework for the design of open- and closed-system storage capable of securely storing stable carbonate minerals over geological timescales. The framework encompasses storage system design principles and considerations regarding the risks associated with potential reversals of stored carbonates.

In addition to the physical aspects of the storage system, this framework also addresses the crucial issue of reversal risk. While stable carbonate minerals offer promising long-term carbon storage potential, there exists a risk of unintentional or premature release of stored carbon dioxide. Factors contributing to reversal risk include hydrological and/or geological instability, human-induced disturbances, and technological failures. The framework incorporates risk assessment methodologies to evaluate and mitigate these potential reversal risks, thus enhancing the overall durability and reliability of the storage system.

We shall discuss the integration of monitoring, reporting and verification (MRV) protocols within the storage framework to ensure ongoing performance evaluation and early detection of any reversals associated with the storage of stable carbonates. Continuous monitoring allows for proactive risk management and timely interventions to prevent or mitigate potential reversals. We believe the implementation of this framework can contribute significantly to the advancement of sustainable carbon storage solutions, improving trust associated with the crediting of CDR projects.