Earth Stewardship Science Research Institute

Drying effects on mineral surface catalyzed atrazine degradation

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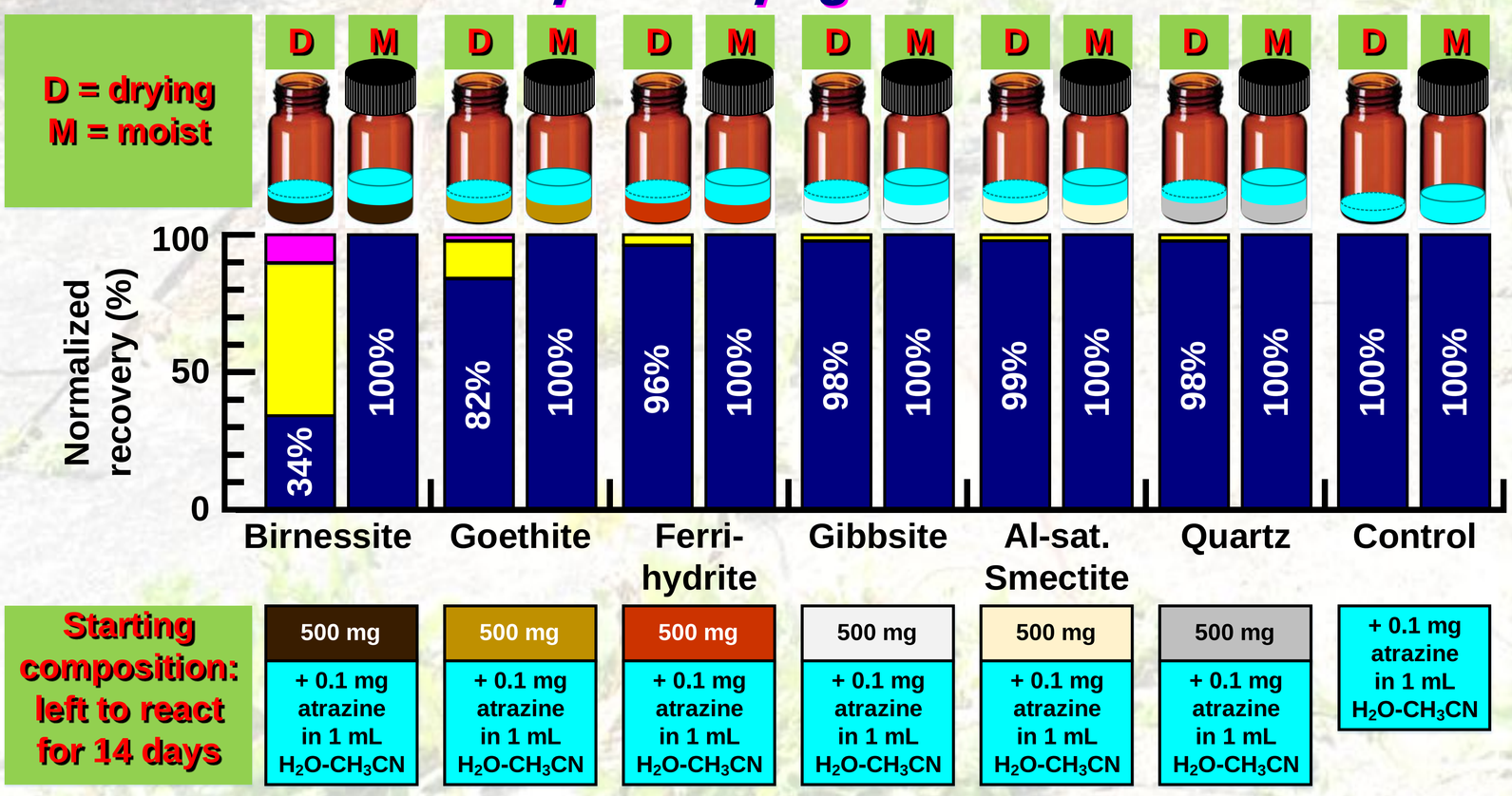
Atrazine, a popular herbicide, endocrine disruptor and possible carcinogen,[1] is frequently detected in water systems. Its biodegradation is well known, but its degradation by soil mineral catalysis is relatively poorly understood. Furthermore, climate change could increase instances of extreme soil drying through evaporation (affects several soil reactions) in the future. Therefore, the degradation of atrazine on the drying surfaces of oxide and clay mineral catalysts was investigated. The effects of using various catalysts as well as the drying rate (using birnessite – most efficient catalyst) was studied. A possible reaction mechanism is also discussed.

Effect of different catalysts – drying vs. moist

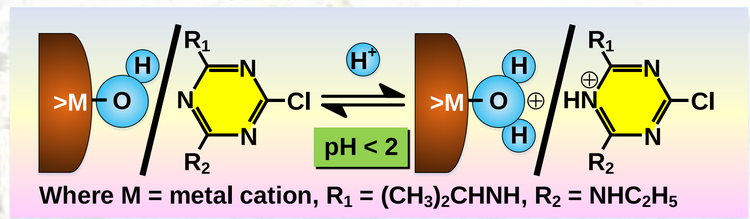


Summary and conclusions

- Drying significantly increases degradation.
- Surface redox potential plays a role, but reaction is net non-redox (no extra Mn^{2+} produced), O_2 plays no role either.
- Degradation initiates at RM ~ 10%.
- Increased drying rate – increased degradation rate.
- Applicable to agricultural soils – windrowing and tilling can cause extreme drying.

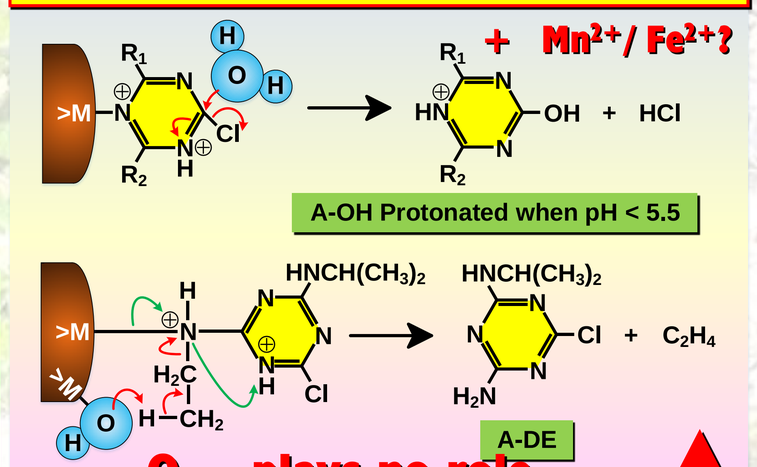
Possible reaction mechanism

- Extreme drying – extreme acidity[2]

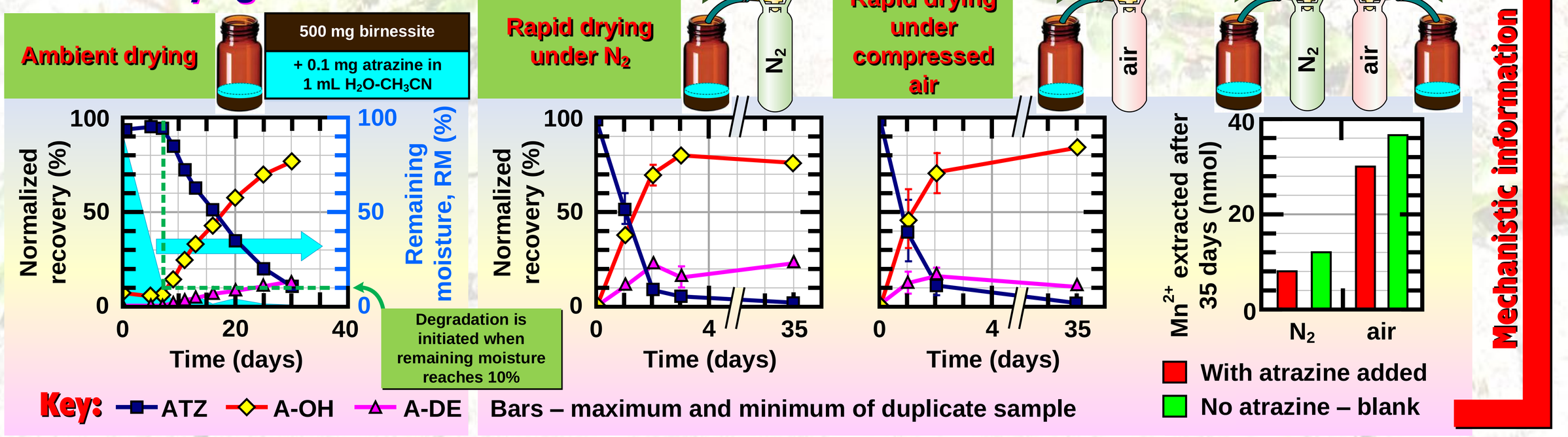


- Exchange – surface complex[1, 3]

Apparent redox potential control – degradation follows Mn^{4+} > Fe^{3+} >> Al^{3+} and Si^{4+} – electrons move within M–N



Effect of drying rate



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Works cited: [1] Shin JY, Cheney MA. *Environ. Toxicol. Chem.* **24**, 1353 (2005); [2] Clarke CE et al. *Geochim. Cosmochim. Acta* **75**, 4846 (2011); [3] Waria M et al. *J. Environ. Qual.* **38**, 1803 (2009).