Designing Soil Covers for Ecological Restoration of Mine Waste

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Iron-ore mining is a major industry in Western Australia. The process of iron-ore extraction results in waste rock which may be backfilled into the pit void or discarded to form ‘waste rock dumps’ and fines, a by-product of crushing iron-ore. Resource companies have a legal and social responsibility to restore waste-rock dumps using local species. However, waste material may not be ideal for plant growth. Hence, as well as gaining an understanding of soil chemical and physical properties of waste materials, it is important to understand the plants interactions with the soil, especially in the early stages of restoration, such as seed germination and seedling emergence. Topsoil may be removed prior to mining, and is a valuable resource, not only because the physical and chemical properties are suitable to support plant growth but it also contains seeds, which, if remain viable during possible topsoil storage, can be used as a source of plants for restoration. However, a topsoil shortage means that alternative soil covers must be used, or a blend of topsoil and waste. This study was conducted at Koolanooka mine, near Morawa, approximately 400 km north of Perth, Western Australia. The mine site is located within the Koolanooka and Perenjori Hills Banded Ironstone Formation (BIF) range, which supports a Threatened Ecological Community (TEC), defined as a community at risk of extinction. We selected a reference community for the restoration of the waste rock dumps that was contiguous with the site, and had a similar geomorphology and slope. On the waste rock dump we spread five soil covers: TEC topsoil; TEC topsoil mixed with waste rock; fines; fines mixed with waste rock, and waste rock by itself. We determined the physiochemical and hydrological properties of the soil covers, and quantified seedling emergence from sown seed. Seedling emergence was greatest in topsoil, but the addition of 25% waste rock to topsoil didn’t restrict seedling emergence, indicating if there is insufficient topsoil to spread over the entire waste rock dump, it could be mixed with a small amount of waste rock. However, seedling emergence on waste rock only was negligible. Interestingly, the seedling community from sown seeds differed the between the soil covers, suggesting an interaction between soil properties and seed traits. We also assessed ex-situ and in-situ germination and in-situ emergence, and manipulated soil microsites using ripping, and found both demographic and microsite limitations to seedling emergence.