**Critical Minerals ‘24**

**Battery Minerals, or Battery Metals? That is the Question, but what about Battery Materials?**

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Everyone is talking about batteries these days, and the metals that we need to manufacture them. But in fact what they often mean is that we need battery minerals in order to make the metals. And then of course there are the materials that are required to manufacture the batteries. This line of thinking has led to a new understanding of what we actually need to make batteries – and is known as the M4 concept (**m**inerals, **m**etals, **m**aterials, **m**anufactured products). This comes with challenges, as now geologists, mineralogists, material scientists and product engineers all need to communicate with each other, in order to source, process, produce and recycle batteries. But unexpected discoveries have been the result. Underutilized and sometimes forgotten technologies have suddenly started to become mainstream as the need for characterization of battery minerals moves at a pace. For example, Raman, LIBS, FTIR and hyperspectral imaging techniques are finding applications where previously not tested, and can now be used on lithium, graphite, cobalt, and nickel ores with great effect. Isotopes are particularly useful for establishing the provenance (traceability) of the minerals, with unusual systems such as lithium- and copper-isotopes showing much promise. All these developments suggests that the study of critical minerals is a vibrant and highly-evolving area of research and commercial activity, providing a much-needed boost to the Green Energy Transition, a more sustainable use of earth resources, and a bright future for all those involved.