The overwhelming majority of iron ore and coal for export is transported on heavy haul rail systems. New steel alloys for both rails and wheels are being developed to allow for even higher loads to improve the network efficiency and the bottom line of these operations.

However, the higher alloy content in these steels can lead to issues with welding of the rails, and pose a substantial safety risk. A derailment can cost tens of millions of dollars in lost production.

The Institute for Rail Technology (IRT) at Monash University, which has BHP Billiton, Rio Tinto, FMG and Vale (four of the largest iron ore producers) as clients, is investigating with the Australian Synchrotron how elements like manganese can distribute unevenly in steel alloy rails, to avoid such failures.

X-ray Fluorescence Microscopy can be used to study single biological cells - or help IRT to understand how to avoid failures of heavy steel rail weld under massive loads.