Regarding "Phase Transformations and Metallization of Magnesium Oxide at High Pressure and Temperature," by R. S. McWilliams, D. K. Spaulding, J. H. Eggert, P. M. Celliers, D. G. Hicks, R. F. Smith, G. W. Collins and R. Jeanloz

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Recommended with a Commentary by Steve Berry, University of Chicago.

This paper is perhaps a bit unusual for the Journal Club, since its intended primary audience is the geophysics community, rather than the condensed matter physicists. However its content should be at least as interesting to the latter group as to the former. That Magnesium oxide undergoes a solid-to-solid phase transition at a high temperature and pressure is not unexpected. That it undergoes a second transition from an insulating state to a metallic, conducting state at a still higher temperature and pressure is quite interesting but that's not an unknown phenomenon. What is especially interesting about this system is that the metallic state is not crystalline, but instead, is a liquid. We of course normally expect that high pressures effectively coerce component atoms to remain in specific sites, whether as crystals, quasicrystals or amorphous solids. That a simple oxide, a well-known insulator under our ordinary conditions of observation, could become a liquid, metallic material at the extremely high temperatures and pressures achieved in these shock-wave experiments has important implications for the cores of earth-like planets with masses several times that of the earth itself. However these results also should stimulate our community to examine what the properties are of such a transition, and just what dynamics enable the material to be liquid, rather than solid. What kind of mobility can go on under those conditions? And what kind of phase transition is it that takes the system from its high-pressure CsCl dielectric structure to that metallic liquid?