Wheeler work on diffusion creep, Nonhydrostatic Thermodynamics (NHT) and other physical-chemical interactions

There are 24 papers here and I add some early abstracts to show how long I've been working on these topics. I also note Ch 6 of my PhD thesis which developed into, but has much in common with, Wheeler 2018.

Fundamental NHT ideas

* Wheeler, **1985.** [*The thermodynamics of rocks under anisotropic stress*]. abstract,
* Wheeler, **1985.** [*Thermodynamics of rocks under anisotropic stress: a discussion*]. abstract discoverable on Web of Science and http://jgs.lyellcollection.org/content/142/6/1239
* Wheeler, **1986.** [*Physical and Chemical Processes in Ductile Shear Zones*]. PhD Ch 6 in particular
* Wheeler, **1987.** [*The significance of grain-scale stresses in the kinetics of metamorphism*]. I showed how local stresses will cause growth and dissolution rates to be coupled when solid state reactions are accomplished by grain boundary diffusion
* Wheeler, **1989.** [*Local stresses as the dominant drive in metamorphic texture development*]. abstract

There's a big time gap here but only because the work developed in terms of diffusion creep, and comes under those headings, see below. Then in the 2010s I returned to fundamental topics.

* Wheeler, **2014.** [*Dramatic effects of stress on metamorphic reactions*]. I used an extension of my ideas on how diffusion creep theory overlaps with theory of solid state reactions to show that stress may have a large effect
* Wheeler, **2015.** [*Dramatic effects of stress on metamorphic reactions: Reply to Fletcher*]. Reply to an attempt to refute Wheeler 2014
* Wheeler, **2015.** [*Dramatic effects of stress on metamorphic reactions: Reply to Hobbs and Ord*]. Reply to another attempt to refute Wheeler 2014
* Wheeler, **2018.** [*The effects of stress on reactions in the Earth: sometimes rather mean, usually normal, always important*]. a review of NHT based mainly on Larche and Cahn 1985, with added discussion of grain boundary aqueous films, and of general geological implications
* Wheeler, **2020.** [*A unifying basis for the interplay of stress and chemical processes in the Earth: support from diverse experiments*]. This is where I am at – the theory here is relevant for various processes from the Earth's surface through to the base of the mantle.

Modelling work on diffusion creep with multiple soluble phases

This is where work on diffusion creep overlaps with NHT (although to some extent it all does). Some unsolved numerical issues, and predictions yet to be tested experimentally.

* Wheeler, **1992.** [*The importance of pressure solution and Coble creep in the deformation of polymineralic rocks*]. Showed how multiphase viscosity might not lie within the bounds suggested by single-phase viscosities; multiphase rocks might be much weaker
* Ford & Wheeler, **2004.** [*Modelling interface diffusion creep in two-phase materials*]. Tricky and still unsolved problem modelling 2 phase creep

Pressure solution and fluid flow

* Sheldon & Wheeler, **2003.** [*Influence of pore fluid chemistry on the state of stress in sedimentary basins*].
* Sheldon, Wheeler, Worden & Cheadle, **2003.** [*An analysis of the roles of stress, temperature and pH in chemical compaction of sandstones*].

Diffusion creep model for single phase, or with insoluble second phase

* Ford, Wheeler & Movchan, **2002.** [*Computer simulation of grain boundary creep*]. Original model
* Ford, Ford & Wheeler, **2003.** [*Simulation of grain boundary diffusion creep: analysis of some new numerical techniques*]. Numerical details
* Ford, Ford & Wheeler, **2004.** [*Simulation of grain boundary diffusion creep: analysis of some new numerical techniques*]. more numerical details
* Berton, Durney, Wheeler & Ford, **2006.** [*Diffusion-creep modelling of fibrous pressure-shadows*]. when 2nd phase is insoluble then diffusion creep can be modelled – an application here
* Wheeler & Ford, **2007.** [*Diffusion Creep*]. Review of diffusion creep model
* Wheeler, **2009.** [*The preservation of seismic anisotropy in the Earth's mantle during diffusion creep*]. Extended code to include spatially periodic boundary conditions. Application to show how CPO might be weakened but not destroyed during diffusion creep (contrary to common assertions). Also suggests a possible microstructural fingerprint of interplay between grain growth and diffusion creep
* Wheeler, **2010.** [*Anisotropic rheology during grain boundary diffusion creep and its relation to grain rotation, grain boundary sliding and superplasticity*]. analytic solution for a single grain shape, showing predicting intense mechanical anisotropy, not ever suspected in geoscience. Work in progress shows this is a feature of more complicated microstructures
* Berton, Durney & Wheeler, **2011.** [*Diffusion-creep modelling of fibrous pressure-shadows II: influence of inclusion size and interface roughness*]. more on 2nd insoluble phase
* Pearce & Wheeler, **2011.** [*Grain-Growth and the Lifetime of Diffusion Creep Deformation*]. not using the numerical model, but showing how grain growth and diffusion creep feedback on each other
* Wheeler, **2013.** [*Thoughts on superplasticity in general and on its role in Earth deformation*]. keynote at Materials Science conference on Superplasticity
* Piazolo et al., **2019.** [*A review of numerical modelling of the dynamics of microstructural development in rocks and ice: Past, present and future*]. section with preliminary results on modelling diffusion creep coupled to grain growth (work in progress)
* Dobson et al., **2019.** [*Anisotropic diffusion creep in post-perovskite: a new model for deformation at the core-mantle boundary*]. a semi-quantitative model for lattice diffusion creep in post-perovskite with anisotropic diffusivity
* Gardner & Wheeler, **2021.** [*The influence of large second phase grains on microstructural evolution during diffusion creep*].

Work with experimentalists on deforming/reacting/porous systems

* Llana-Funez, Wheeler & Faulkner, **2012.** [*Metamorphic reaction rate controlled by fluid pressure not confining pressure: implications of dehydration experiments with gypsum*]. Fluid pressure as dominant control on reaction rate – little effect of confining pressure but not the whole story …
* Leclere, Faulkner, Wheeler & Mariani, **2016.** [*Permeability control on transient slip weakening during gypsum dehydration: Implications for earthquakes in subduction zones*]. Nice examples of localisation in shear bands during reaction
* Bedford et al., **2017.** [*A new 4D view on the evolution of metamorphic dehydration reactions*]. First synchrotron tomography imaging (and movie) of a dehydration reaction
* Bedford, Faulkner, Leclere & Wheeler, **2018.** [*High-Resolution Mapping of Yield Curve Shape and Evolution for Porous Rock: The Effect of Inelastic Compaction on Porous Bassanite*].
* Leclere et al., **2018.** [*Reaction fronts, permeability and fluid pressure development during dehydration reactions*].

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