Non-conventional binders

John L. Provis

Professor of Cement Materials Science & Engineering

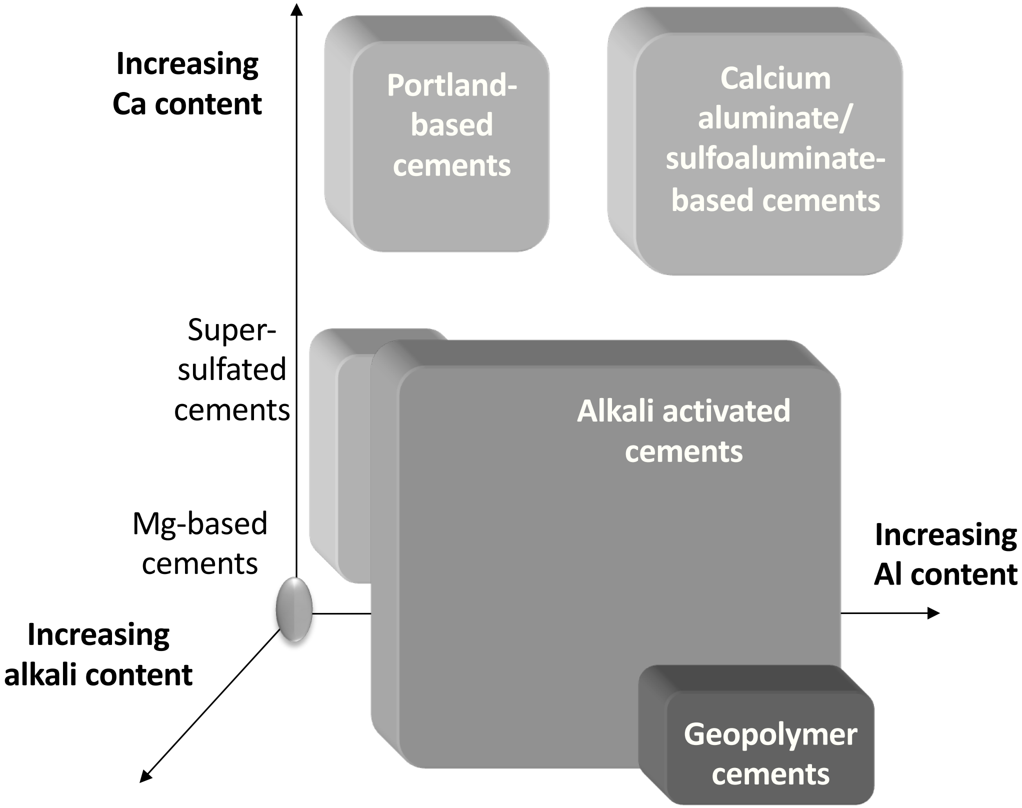
Department of Materials Science and Engineering

The University of Sheffield

j.provis@sheffield.ac.uk

The University Of Sheffield.

Traditional and non-traditional cements



Critical: ***Designing materials that are fit for purpose!*** Robust, cheap, reliable, and local

Adapted from: J.L. Provis & J.S.J. van Deventer (eds.), *State of the Art Report of RILEM TC 224-AAM*, 2014

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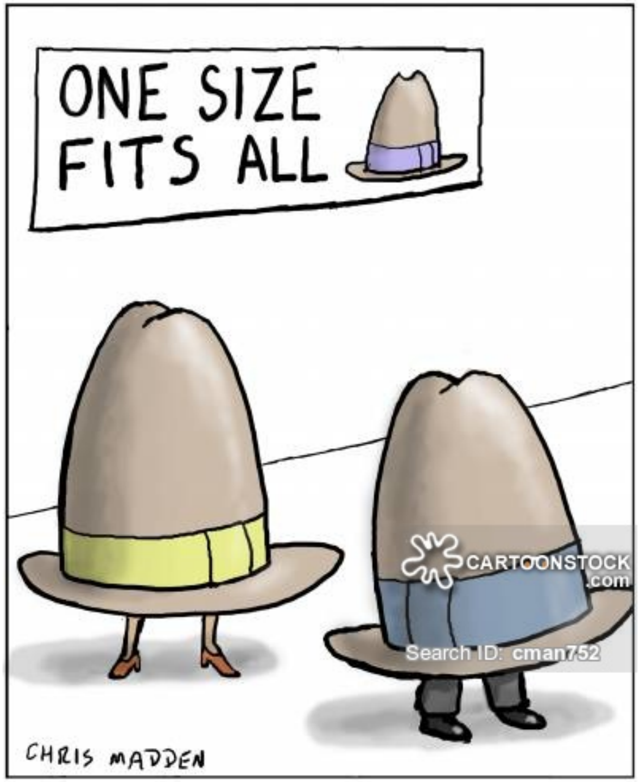
One size fits all?



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Does it necessarily have to be a new idea?

J. Whiting, U.S. Patent 544,706, 1895 – alkali-activated slag

UNITED STATES PATENT OFFICE.

JASPER WHITING, OF CHICAGO, ILLINOIS.

MANUFACTURE OF CEMENT.

SPECIFICATION forming part of Letters Patent No. 544,706, dated August 20, 1895.

Application filed February 5, 1895. Serial No. 537,404. (No specimens.)

S. Sorel, U.S. Patent 53,092, 1866 – Mg oxychloride cement

UNITED STATES PATENT OFFICE.

STANISLAS SOREL, OF PARIS, FRANCE.

IMPROVED COMPOSITION TO BE USED AS A CEMENT AND AS A PLASTIC MATERIAL FOR MOLDING VARIOUS ARTICLES.

Specification forming part of Letters Patent No. 53,092, dated March 6, 1866.

M. Tada, U.S. Patent 1,932,150, 1932 – carbonation curing of cement

UNITED STATES PATENT OFFICE

1,932,150

METHOD OF MAKING CEMENTITIOUS PIPE

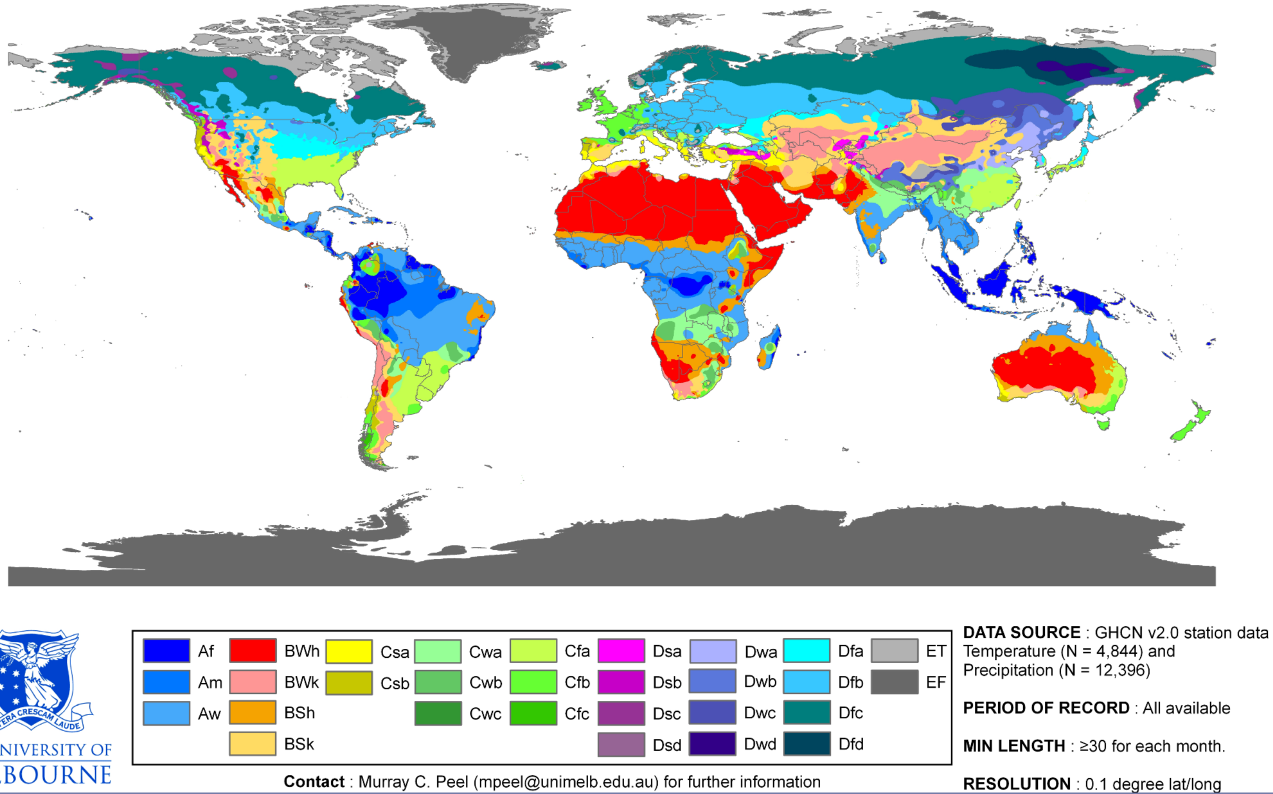
Manabu Tada, Tokyo, Japan, assignor to Frank W. Plane, Chicago, Ill.

No Drawing. Application January 8, 1932 Serial No. 585,640

4 Claims. (Cl. 25—154)

Differences in climate (→ service environment)

World map of Köppen-Geiger climate classification



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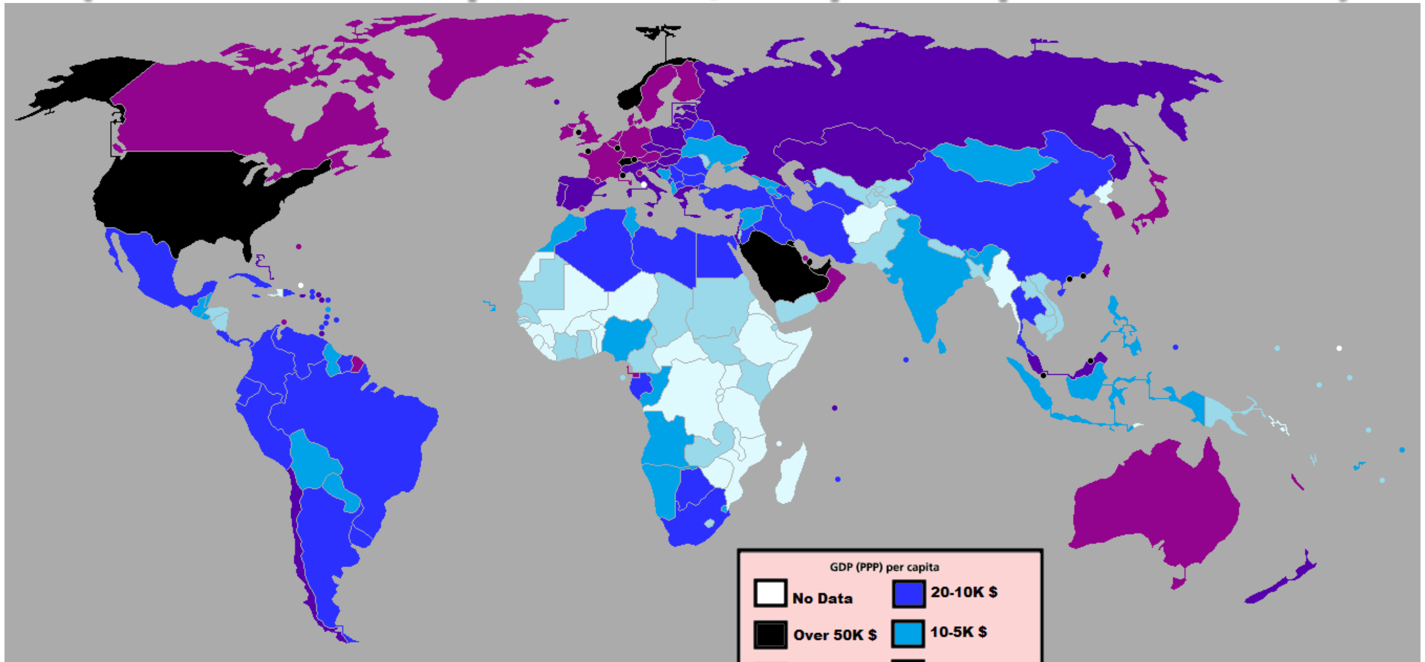
Differences in economic development (→ development/repair priorities)



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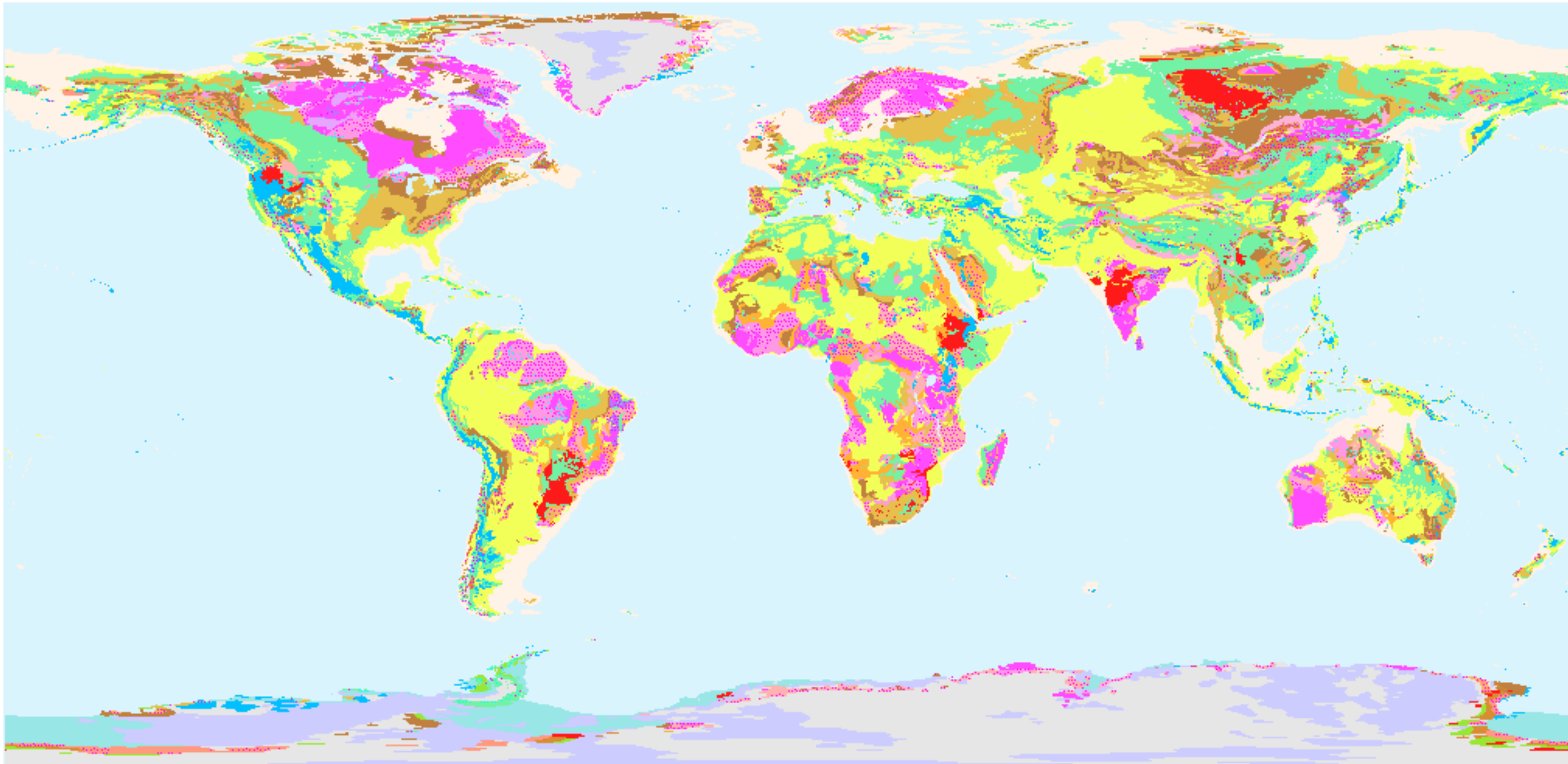
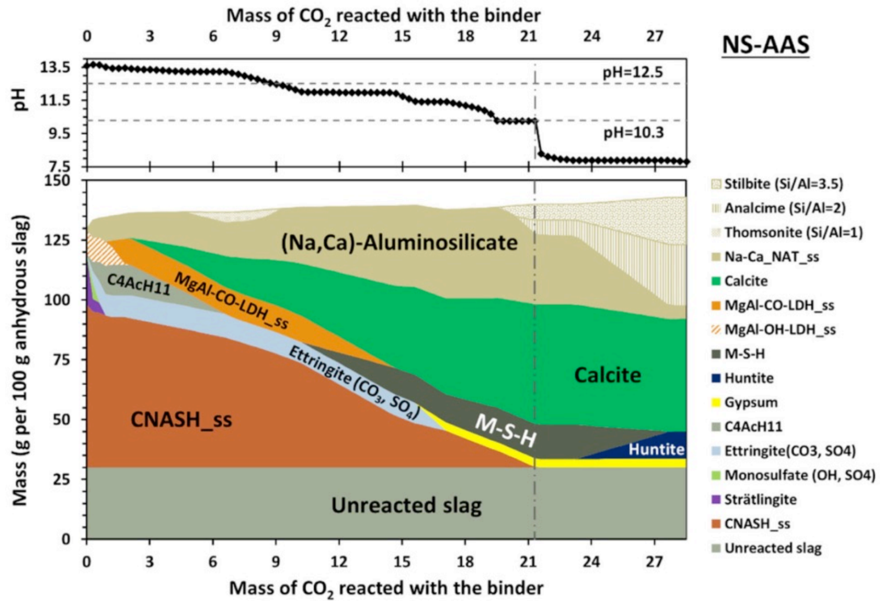
Differences in geology (→ mineral resources)



credit: Commission for the Geological Map of the World

What can we do with all this?

- Does it need to be reinforced?
  - (can be?/should be?)
- Factory vs on-site production
- Durability - fit for purpose, not necessarily for eternity?
- Need predictive capabilities, built from fundamental understanding of gel binder chemistry



Carbonation simulations: X. Ke et al., *Cement & Concrete Research*, 136(2020):#106158

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Looking forward…

- Non-conventional binders can – and must – be tailored to give excellent performance for local scenarios
- Many opportunities to use novel cements
  - Need high quality data to understand fresh & hardened properties
- Most important – the right application
- Material must be robust – precision material, non-precision users (!)
- Material and application must be ‘sustainable’ – including durability
  - Economic and environmental sustainability required
  - Reliable and sufficient volume supply of raw materials
  - Specialty applications raise interesting technical questions

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