



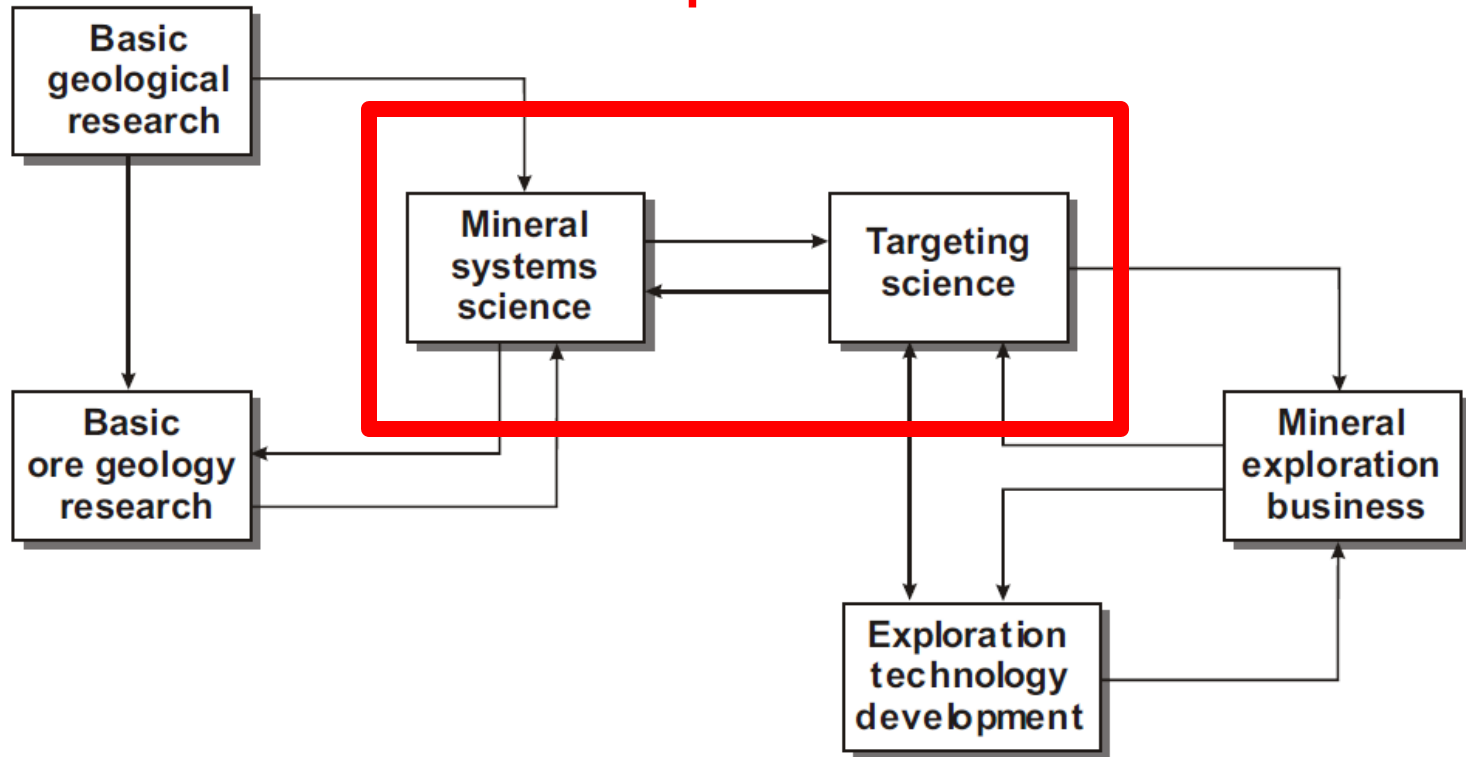
Optimising the Interface between Economic Geology Research and the Industry

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Critical Components of Interface



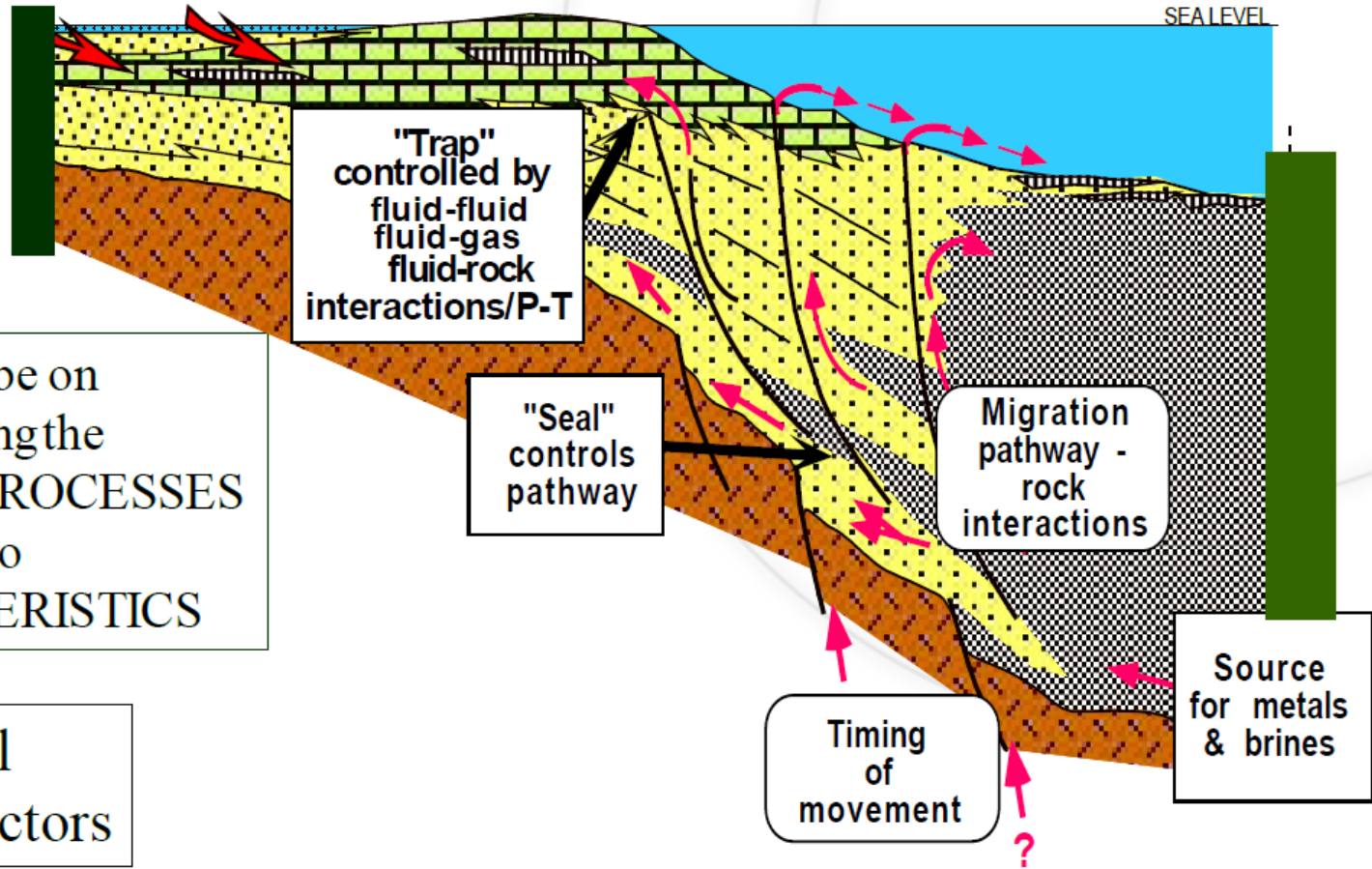
R&D FRAMEWORK FOR
MINERAL EXPLORATION

—————> *Information flow*

Mineral Systems Science: Conceptual Basis

- **Based on the premise that:**
 - ore-deposits (particularly large ones) represent the foci of large-scale systems of mass and energy flux
 - the only way to predict their location or their metal endowment is to understand the entire system
- **These systems comprise a scale-dependant hierarchy of processes:**
 - the largest observable scale of process is usually continental-scale at least

A mineral systems approach



Critical Success Factors

Mass trapping

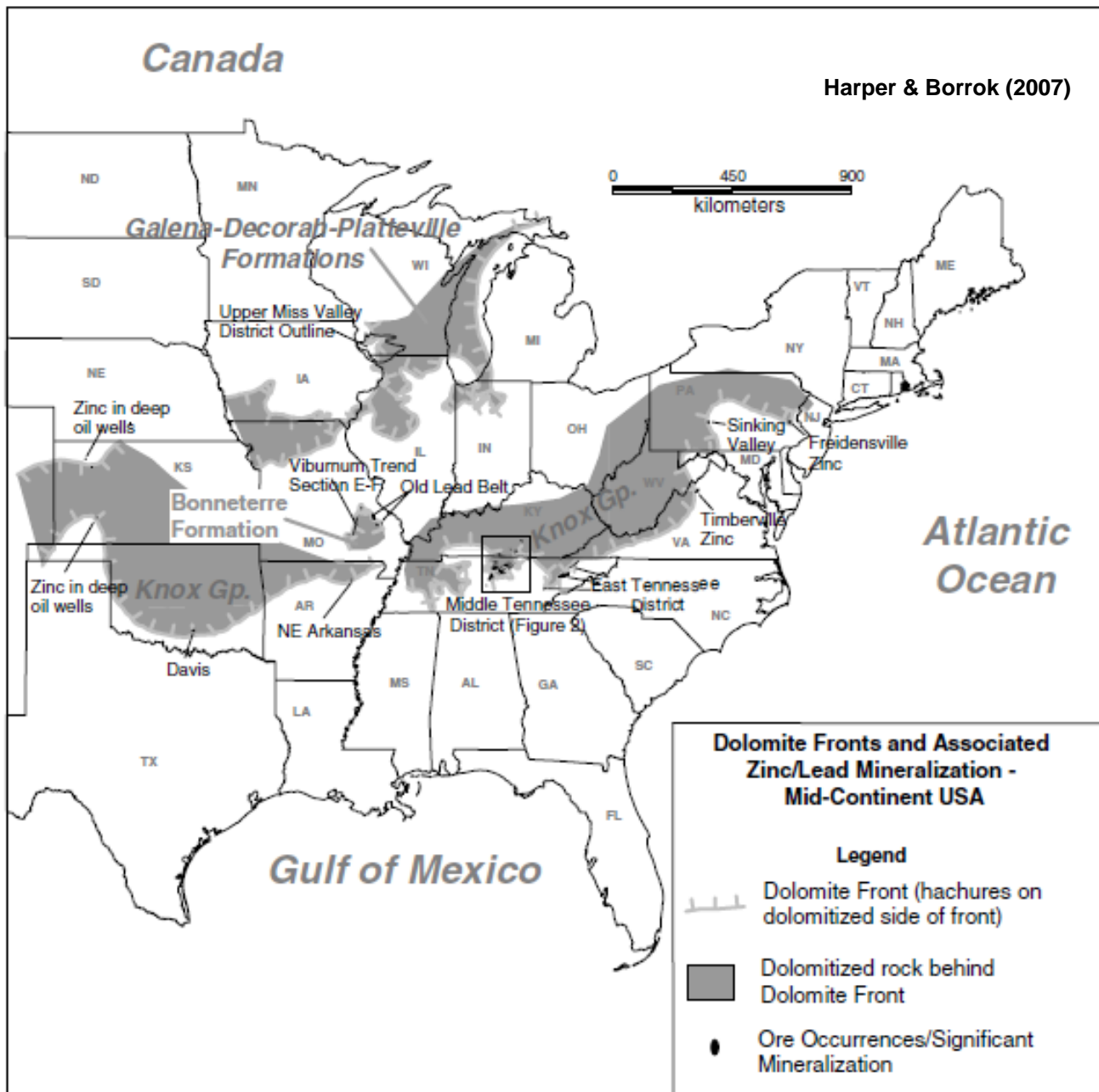


Source - Release - Migration - Trap - Seal

Mass scrubbing



Source(s) - Migration - Throttle - Scrubber



Mineral Systems are Continental-Scale

Goals of Mineral System Science

- To define the key process components of Mineral Systems (at all scales)
- To map these components to physical rock volumes (essential for predictive targeting)
- To define the key generic, unifying process elements that govern ore-forming systems:
 - Major lithosphere-scale permeability pathways
 - Global geodynamic controls
 - Dependence of permeability on active strain
 - Self-organisation (eg in response to flow barriers)
- To develop frameworks for evaluating the relative endowment potential of systems

Mineral System Science as an Integrator

- **Mineral Systems Science is the logical integrator for most other geoscience relevant to ore geology**
- **It is the critical test of the usefulness of new geoscientific knowledge – does it improve our understanding of mineral systems?**
- **Current gaps in Mineral Systems knowledge define the required research agenda**
- **It is the critical framework for developing generic knowledge and principles relating to ore-formation**
 - **Don't need to “reinvent wheel” with every new ore type**
 - **Insights from one ore type may help understanding of another**
 - **Aids prediction of previously unknown ore types**

Targeting Science: What do we mean?

- **The body of knowledge and practical expertise that integrates our geoscientific understanding of mineral systems with the practical constraints of the mineral exploration industry**
- **Four Key Components:**
 1. **Translating knowledge of mineral systems into practical mappable proxies (interface with exploration technology development)**
 2. **Integrating the constraints imposed by previous exploration activities (eg the Exploration Search Space Concept)**
 3. **Developing the most efficient methodologies (automated and manual- need both) for interacting with available data to select and prioritise targets**
 4. **Evaluating which methodologies work best in which context**

1. Translating Mineral System Knowledge into Practical Proxies

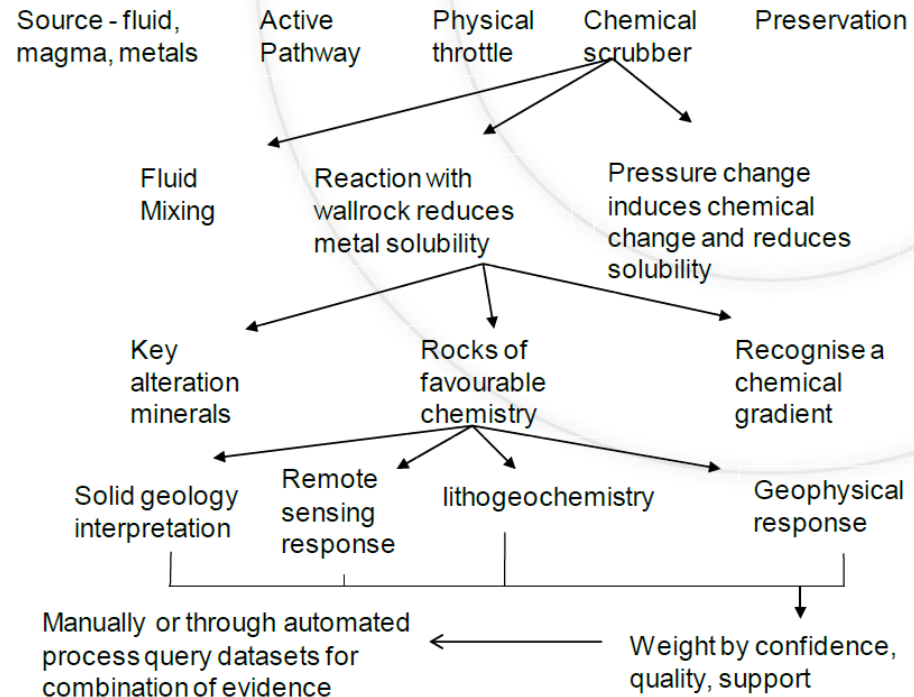
Target Generation from Mineral Systems – Orogenic Au

Critical Processes
(ranking level)

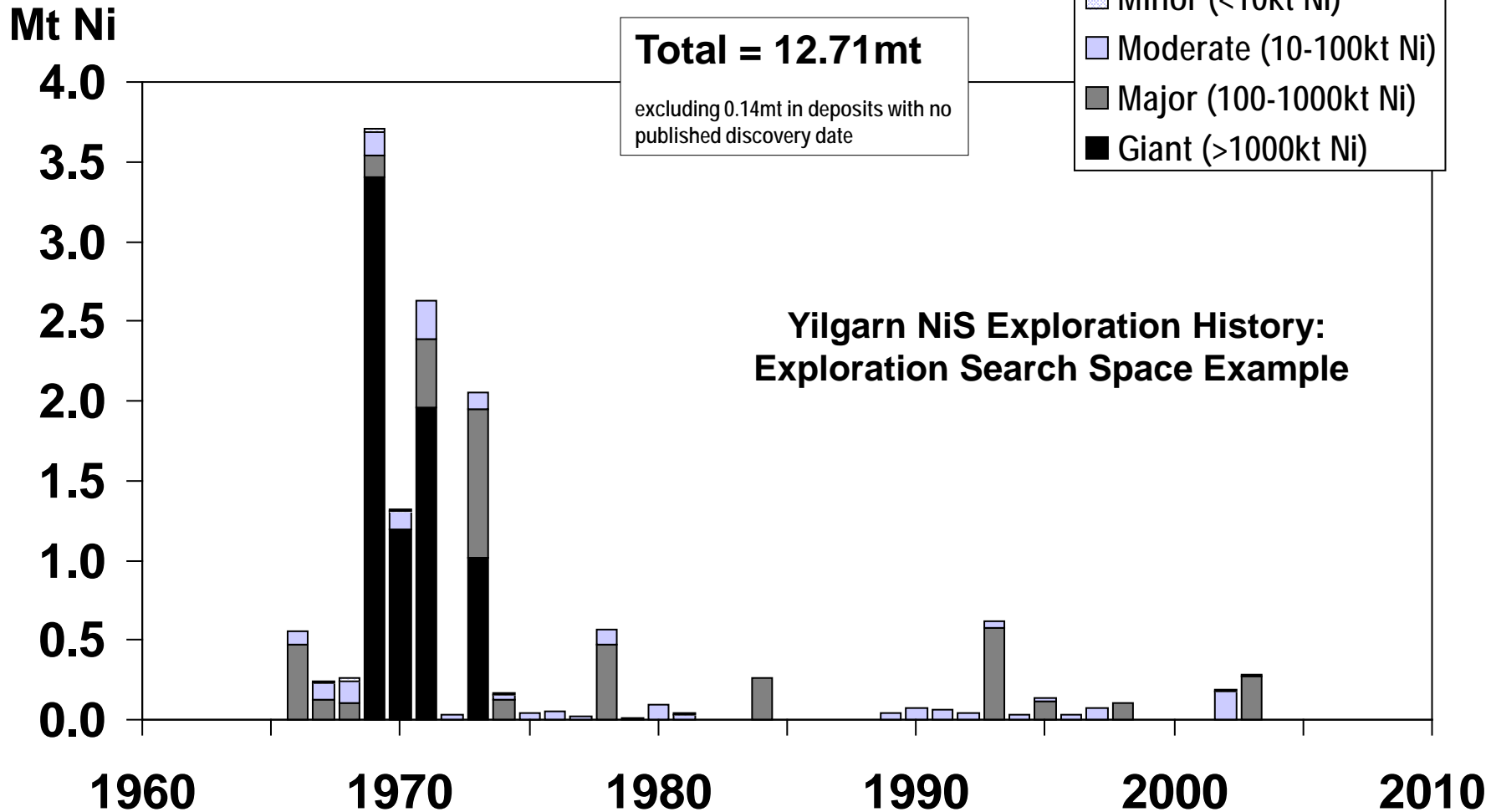
Constituent Processes
(thinking level)

Targeting Elements
(Geological features indicating the processes)

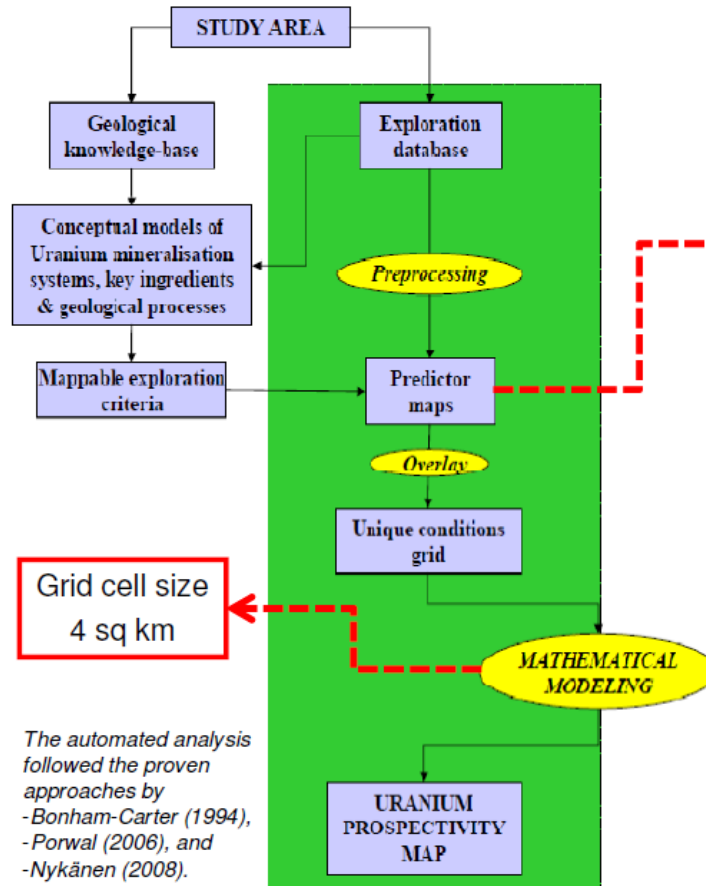
Translation into mappable targeting criteria (proxies and predictor maps)



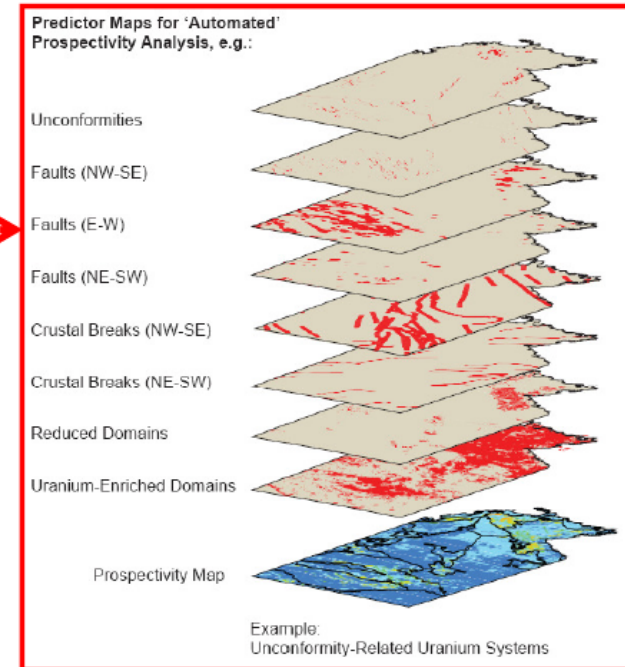
2. Integrating Constraints Imposed by Previous Exploration



3. Developing the Most Efficient Methodologies for Interacting with Data



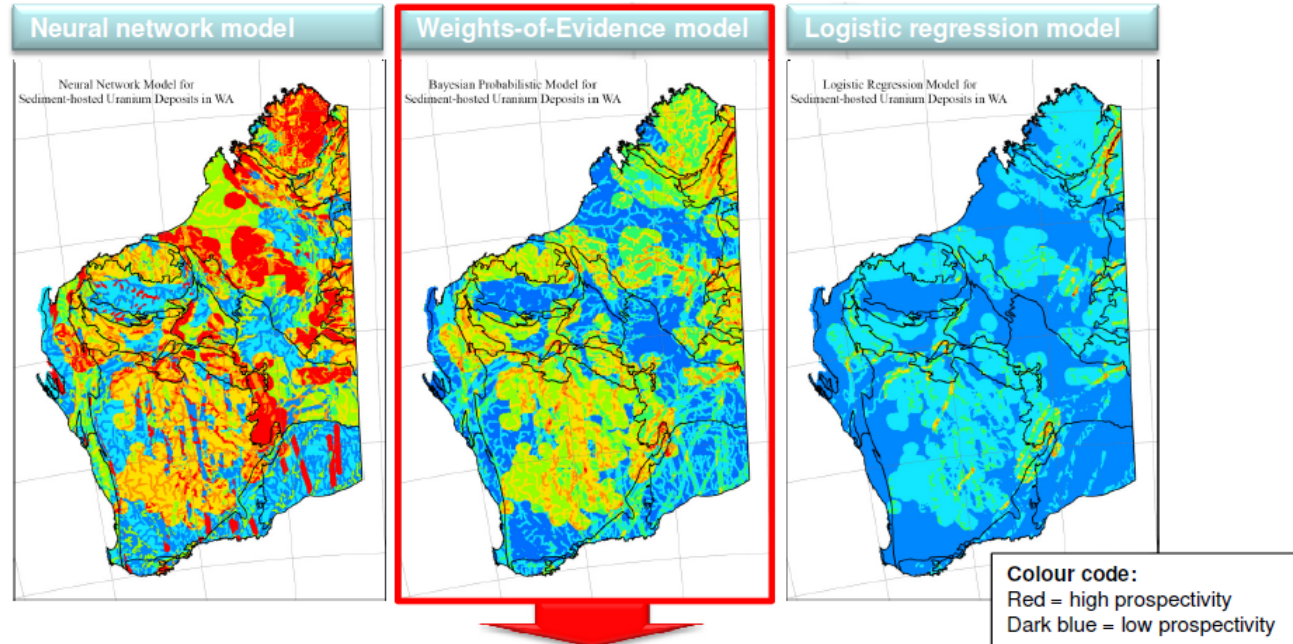
The automated analysis followed the proven approaches by
 - Bonham-Carter (1994),
 - Porwal (2006), and
 - Nykänen (2008).



In other words... Combining all mappable exploration criteria and quantifying the spatial association of each possible combination of these criteria with the known uranium occurrences



4. Evaluating What Works Best, and When and Why



- **After initial tests the WOE model was selected as the model of choice**
 - The distribution of relative prospectivity is similar to that obtained from the other models
 - Robust and well-documented approach to modelling that is intuitive and easier to implement
 - Purely data driven: greater objectivity + complementary to the conceptual 'manual' analysis
 - Provides estimates of stochastic uncertainties and relative importance of predictor maps

Conclusion

- **Historically, there has been a significant disconnect between the “academic” science of economic geology and the practical business of mineral exploration**
- **Given the challenges of resource depletion and undercover exploration in the 21st Century, it is critical that we change this**
- **The key to this is developing the sub-disciplines of Mineral Systems Science and Targeting Science**
- **These two sub-disciplines are essentially to the effective interface between geoscientific research and practical mineral exploration**