

# The Precarious Global Geopolitics of Phosphorus

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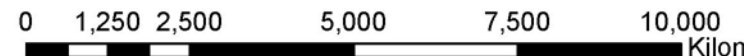
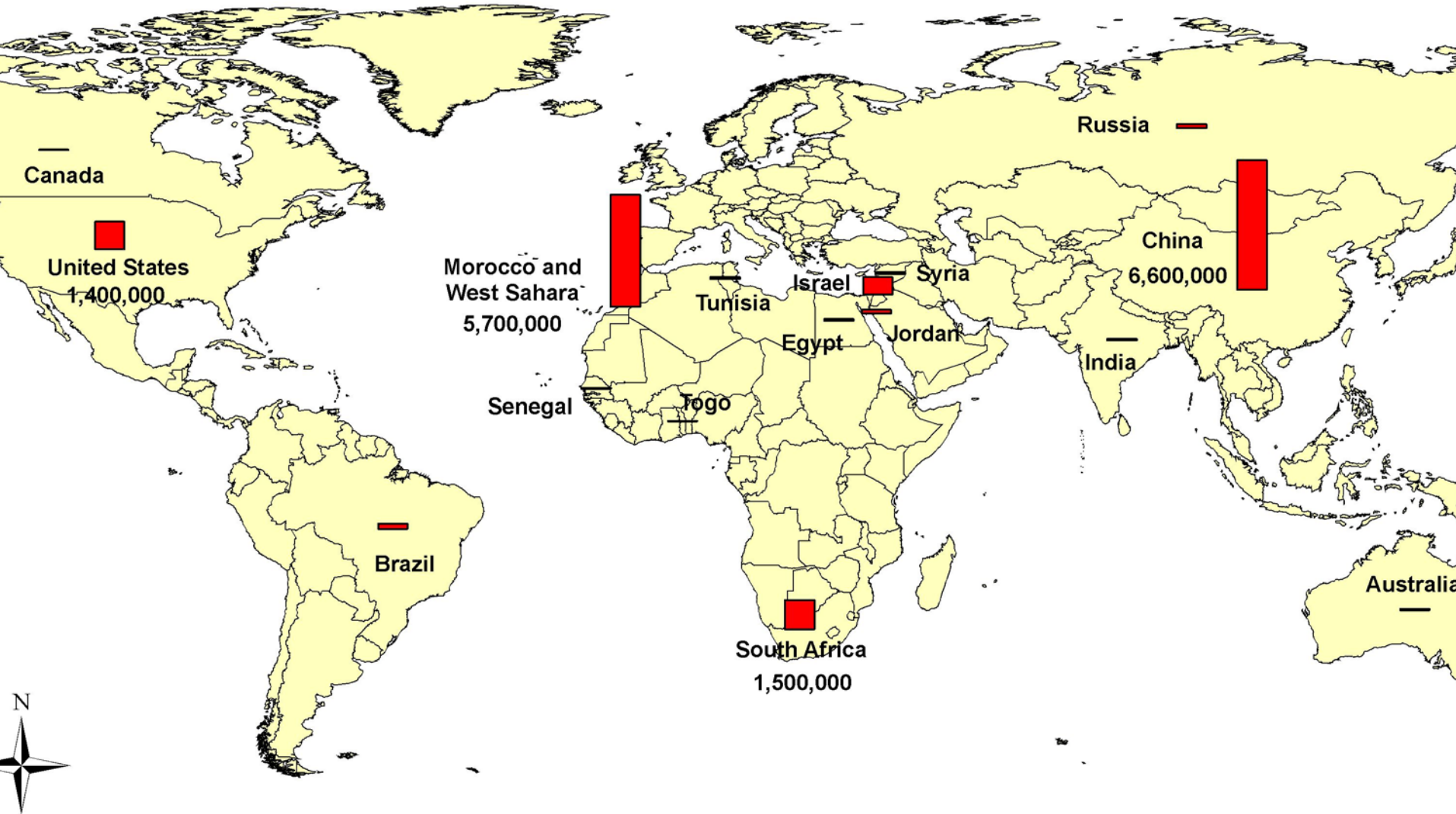
International Conference on Sustainable Sanitation  
Dongsheng, China 2007

# The Story Line

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- Little is published on the risks and limitations of global supply and demand of phosphorus
  - But after reviewing the available data there is cause for considerable concern
  - The US will deplete its commercially-viable reserves within 25-30 years
  - Most of the commercially-viable reserves are found in only two locations on the planet in Morocco/Western Sahara and in China
  - India is dependent on foreign sources of phosphate mainly from Morocco
  - The global economy could flip from oil- to phosphorus-based 15-20 years
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# Phosphate Rock - Worldwide Reserve Estimates (thousands of metric tons)

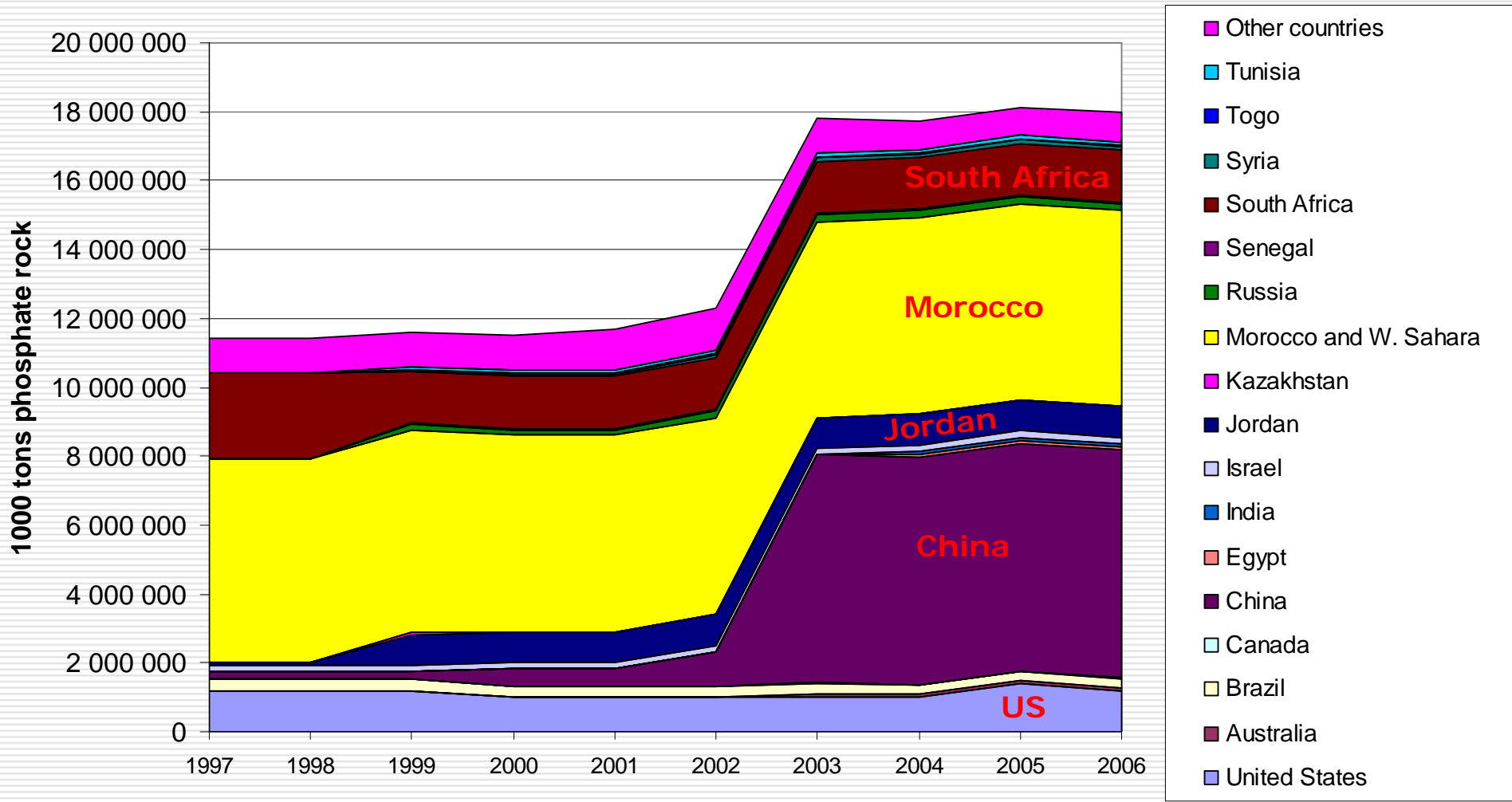


# Phosphorus Use Since 1950

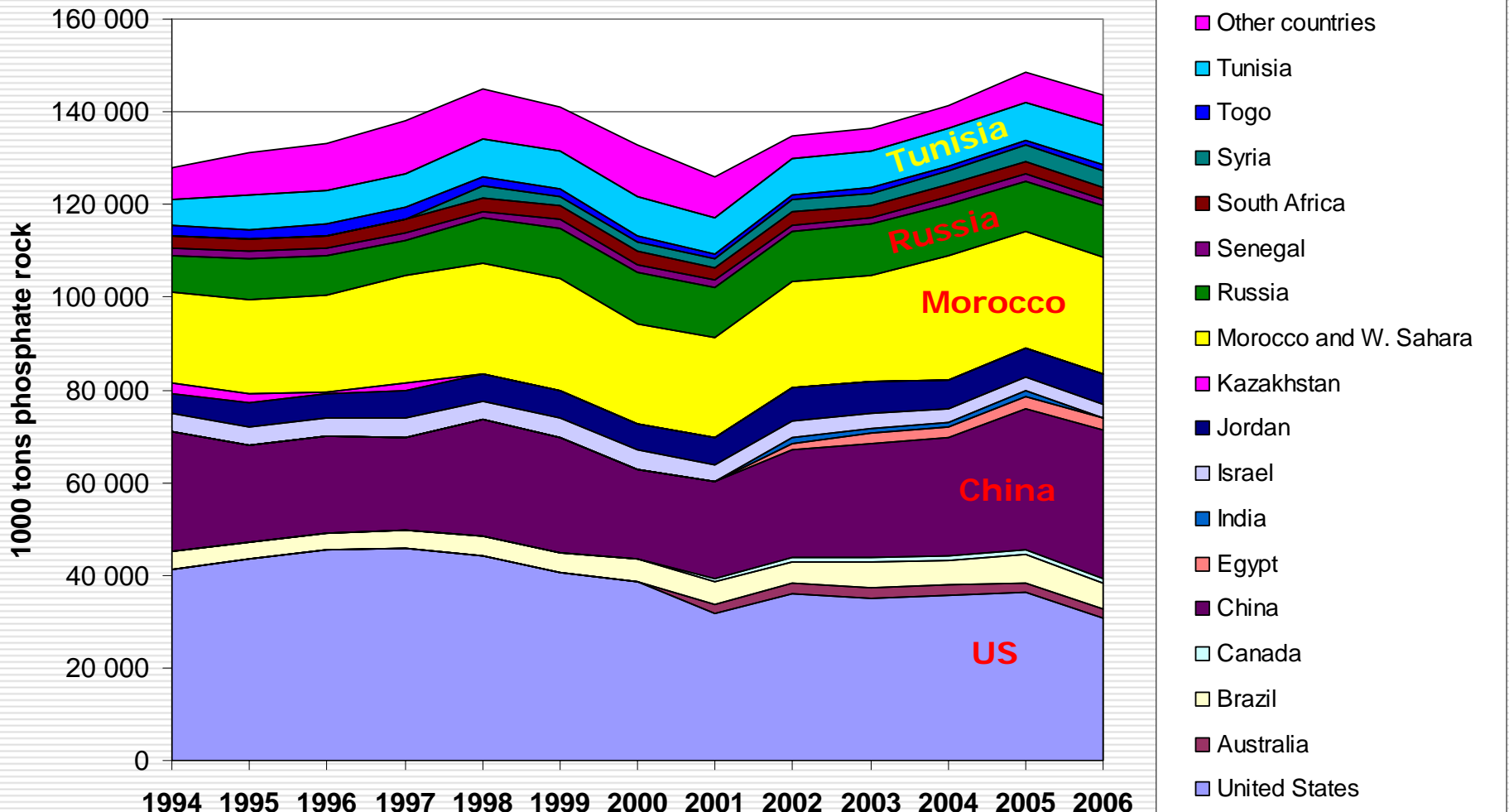
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- Between 1950 and 2000, about 1 billion tons of P has been mined
- During this period, about 0.8 billion tons of fertilizer P were applied to the Earth's croplands
- This has increased the standing stock of P in the upper 10 centimetres of soil in the world's croplands to roughly 1.3 billion tons, an increase of 30%
- Close to a quarter of the mined P (0.25 billion tons) since 1950 has found its way into the aquatic environment (oceans and freshwater lakes) or buried in sanitary landfills or *sinks*

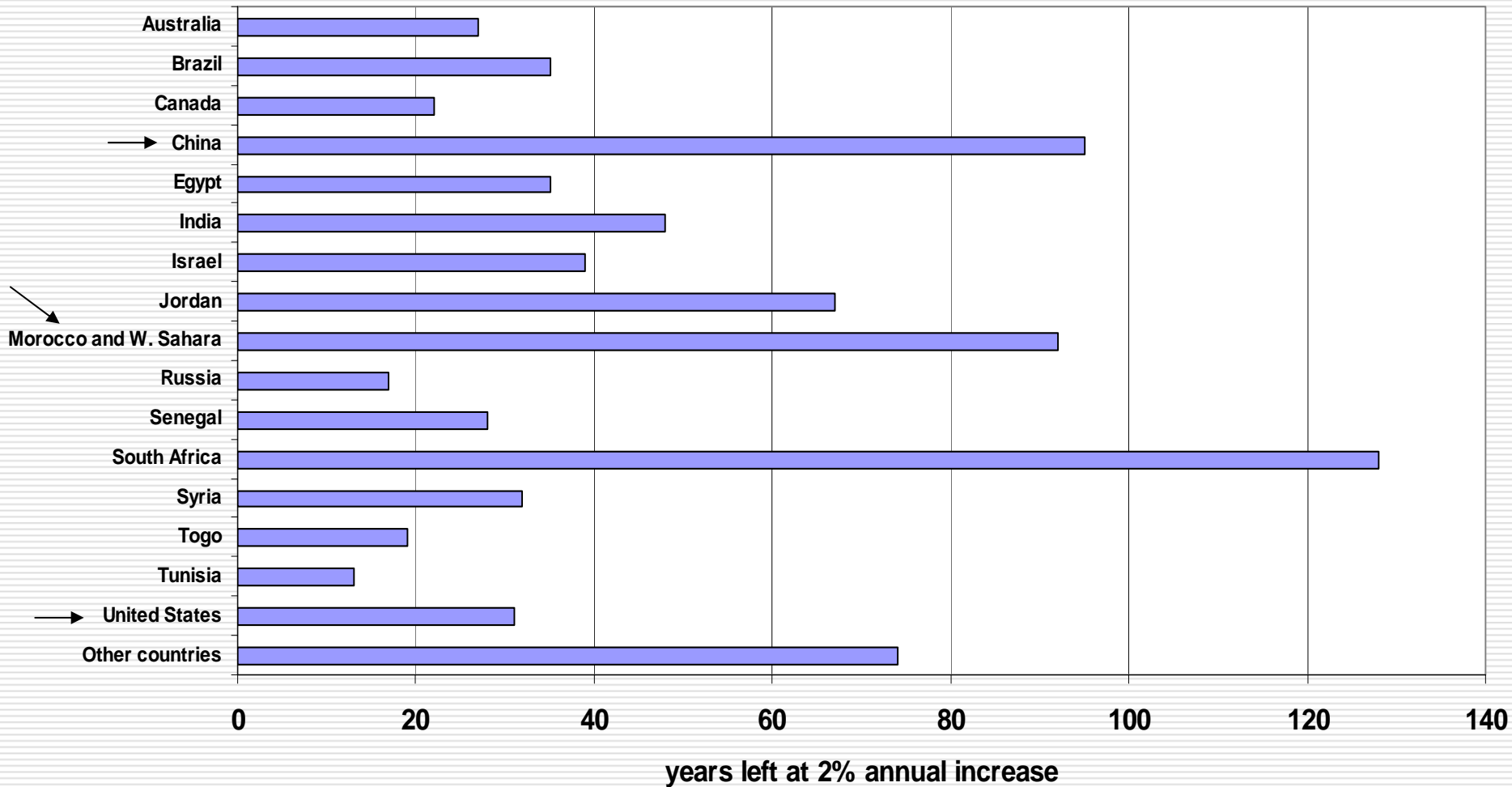
# Phosphate Rock Reserves, 1997-2006 (from USGS summaries)



# Mine Production of Phosphate Rock, 1994-2006 (from USGS)



# Phosphate Rock - Years of Extraction Remaining Based on Current Economic Reserves from 2006 (2% annual increase)



Source: USGS

# The Battle for Phosphate in West Africa

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- ❑ Western Sahara is the last African colonial state still to declare its independence. It was administered by Spain until 1976
  - ❑ Following this it was invaded by Morocco and occupied until 1988
  - ❑ An agreement was made between Morocco and POLISARIO to determine the peaceful future for Western Sahara
  - ❑ The United Nations Mission for the Referendum in Western Sahara (MINURSO) was set up in 1991
  - ❑ Since then plans for the referendum to determine the future of Western Sahara have been debated and postponed
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# Geopolitical Scene Today

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- ❑ 25-30 yrs left of cheap reserves in the US
  - ❑ 2006 was a 40-year low in US production and the reported economic reserves are now decreasing
  - ❑ US signed free-trade agreement with Morocco in March 2004
  - ❑ Since 2006, China extracts more phosphate rock than the US (and Morocco)
  - ❑ India is the largest importer of phosphate and is dependent entirely on Morocco
  - ❑ EU remains silent - "watch and see what happens"
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# Phosphorus is lost to the soil

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- Most of the phosphate we have applied as fertiliser is bound to the upper soil layer and not available for plant production
  - The only practical method to free up phosphate from soils is slash and burn
  - Biotechnology may be important in order to devise ways of extracting phosphorus – but this will cost
    - e.g. white lupin (*Lupinus albus*) is a grain legume used for nitrogen fixation which also excretes small amounts of organic acid from its rootlets
    - gene-modified soil bacteria and plants in order to achieve higher plant availability and recovery
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# Food Security

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- ❑ Meat consumption in Asia is increasing and by 2030 it will have increased 5-fold from 2000, increasing the demand for fertiliser
  - ❑ As P-reserves dwindle and geopolitical positioning intensifies, the price of phosphorus will increase
  - ❑ Food security will become the central issue in countries that cannot afford to keep pace
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# Probable Scenarios by 2020

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- ❑ Depletion of US cheap reserves in about 10-15 years time
  - ❑ US offshore mining of phosphate begins
  - ❑ Global price hikes in fertilisers and grains
  - ❑ Morocco leads new OPEC for phosphorus
  - ❑ China applies domestic sustainable development policy – self-sufficient in phosphorus and booming economy
  - ❑ India's economy heavily stressed by global price of phosphorus
  - ❑ Global economy flips from oil- to phosphorus-based
  - ❑ Innovations for phosphorus recycling now a high priority
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# Probable Scenarios by 2020 (cont'd)

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- ❑ Zero-waste source-separation and recycling in agro, solid waste and water/sanitation sectors (eg ecosan)
  - ❑ Composting and urine diversion becomes global standard for urban agriculture
  - ❑ Global convention on nutrient use and recycling
  - ❑ Biotechnology developing root-nodule bacteria in legumes that extract phosphate from agrosoil – part of global convention on GMOs
  - ❑ Vegetarian diet and aquaculture increases, meat production decreases
  - ❑ Poor countries use widespread slash and burn to release soil phosphorus creating regional atmospheric pollution
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# Conclusion

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- ❑ At current rates of extraction (144 megatons per year) with no annual increase the commercially viable reserves will last 125 years
  - ❑ At 1-2% annual increase, this will be 100 years
  - ❑ At 3% annual increase, this will be only 50 years
  - ❑ Morocco/West Sahara and China hold >70% of the global reserve
  - ❑ US cheap reserves will be depleted in 25-30 years
  - ❑ By already 2020, rock phosphate may be the keystone resource of the world economy
  - ❑ The geopolitics of phosphorus make this one of the most precarious global resource questions requiring immediate attention
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