

The oxidation and reduction of ilmenite in chemical-looping combustion: A phase-chemical description

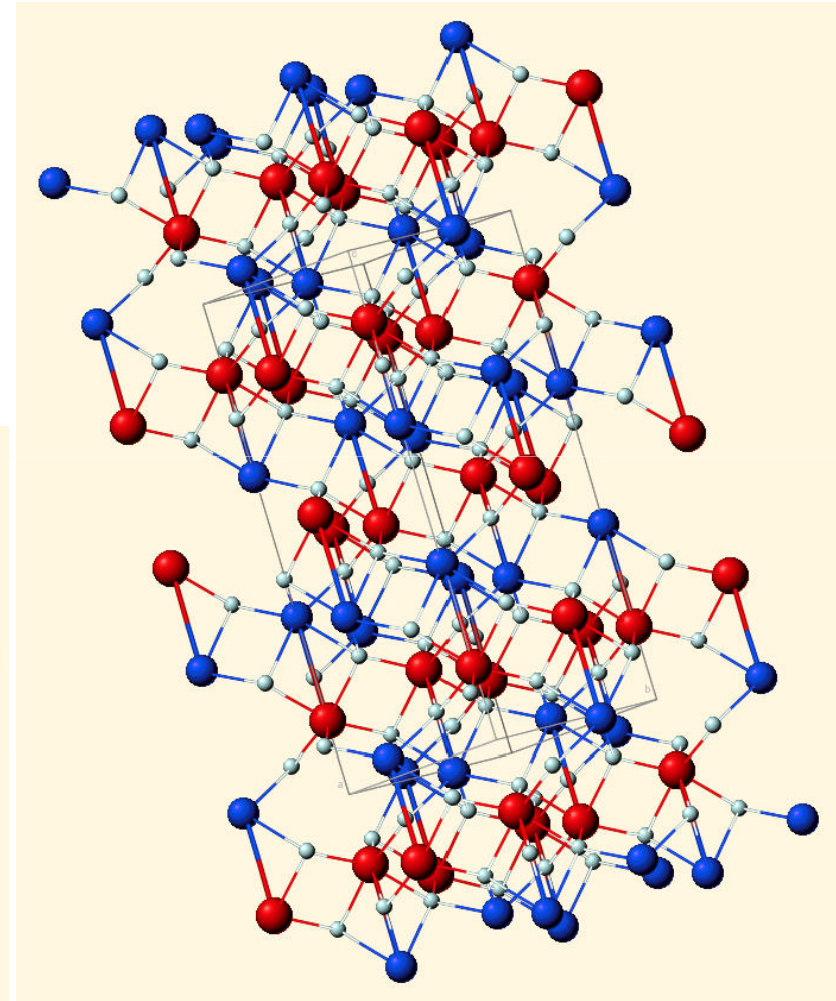
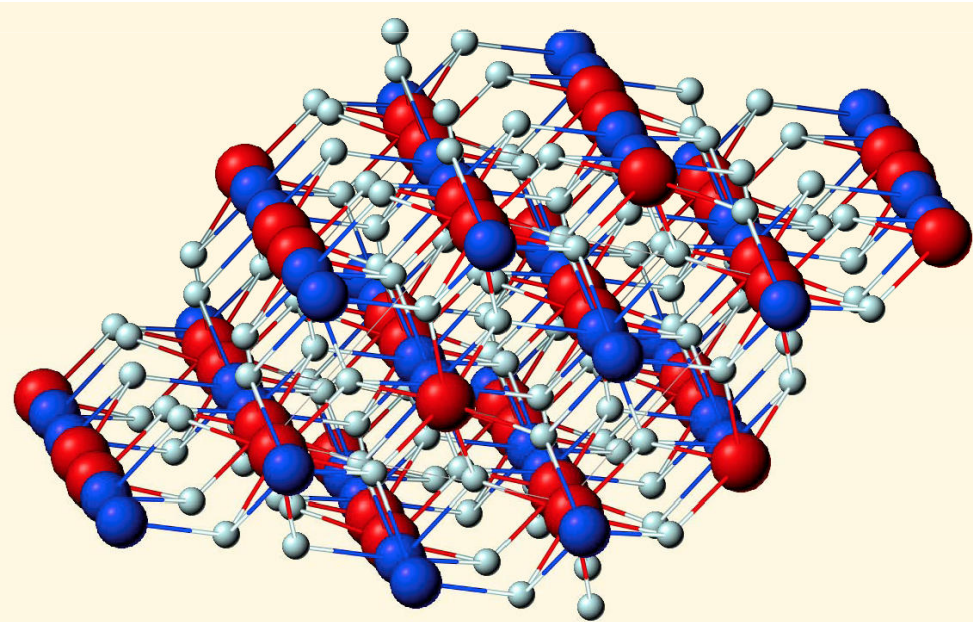
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- TiO_2 pigments accounts for over 95% of titanium consumption
- Ilmenite (FeTiO_3) is the principal source of titanium
 - ❑ Rutile (TiO_2)
 - ❑ Titaniferous magnetite ($[\text{Fe},\text{Ti}]_3\text{O}_4$)
- South Africa and Australia produce half of the world's TiO_2 feedstock
 - ❑ Secondary, beach-sand deposits (heavy mineral)
 - ❑ Primary, hard-rock deposits (Canada and Norway)
- Upgrading
 - ❑ Synthetic rutile (>95% TiO_2)—solid-state reduction (1200°C)
 - ❑ Titaniferous slag (86% TiO_2)—6-in-line and DC-arc furnaces

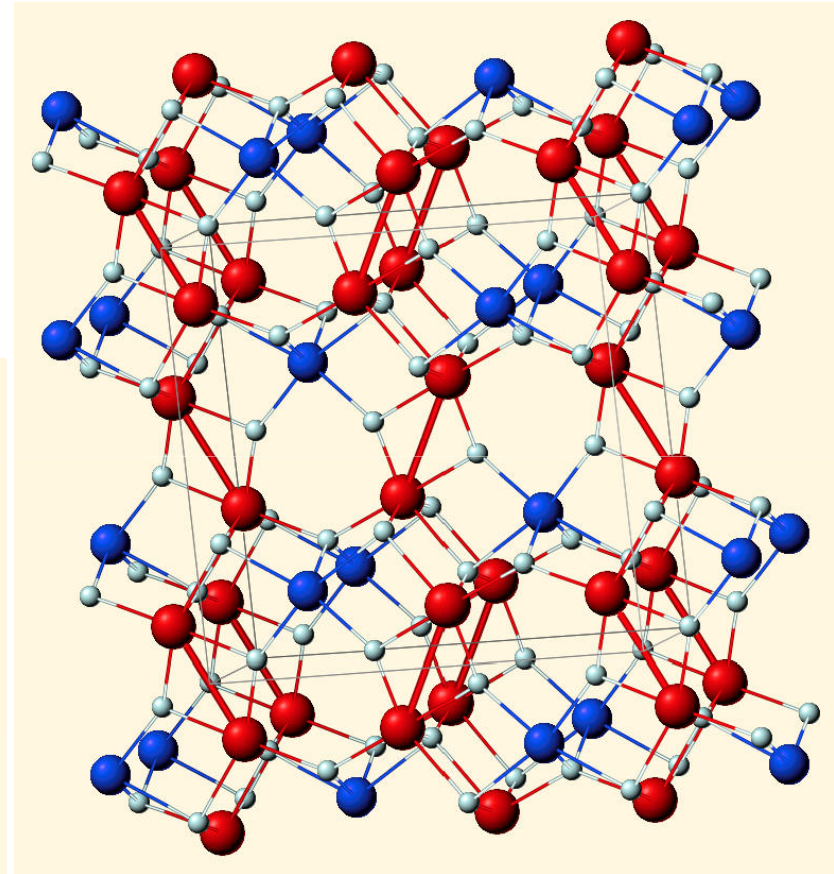
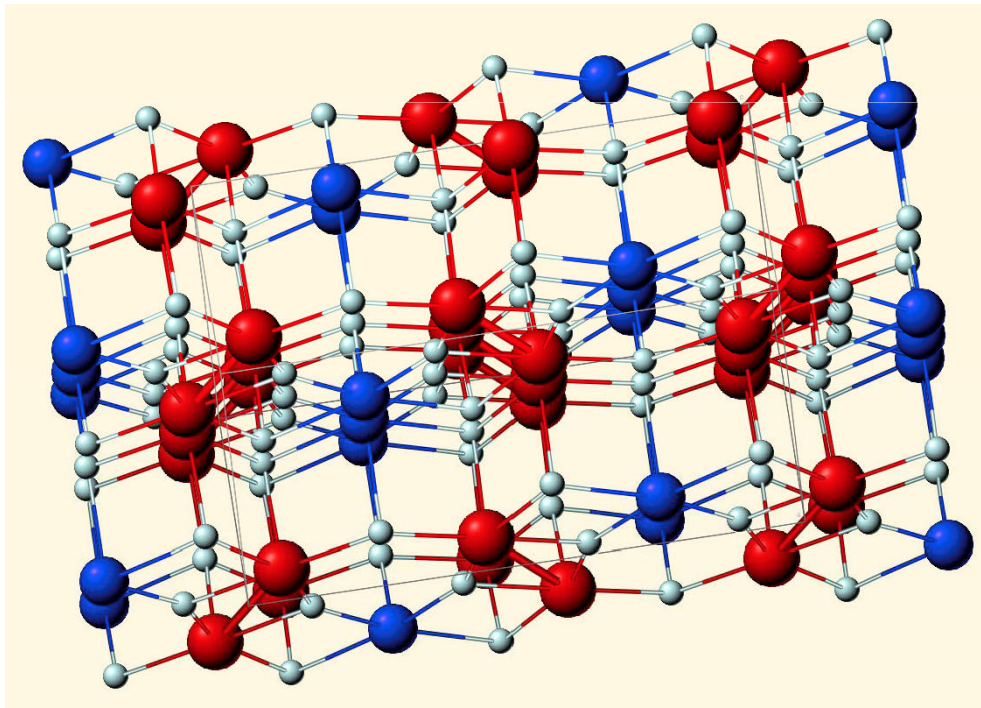
FeTiO₃ (ilmenite)

- iron
- titanium
- oxygen

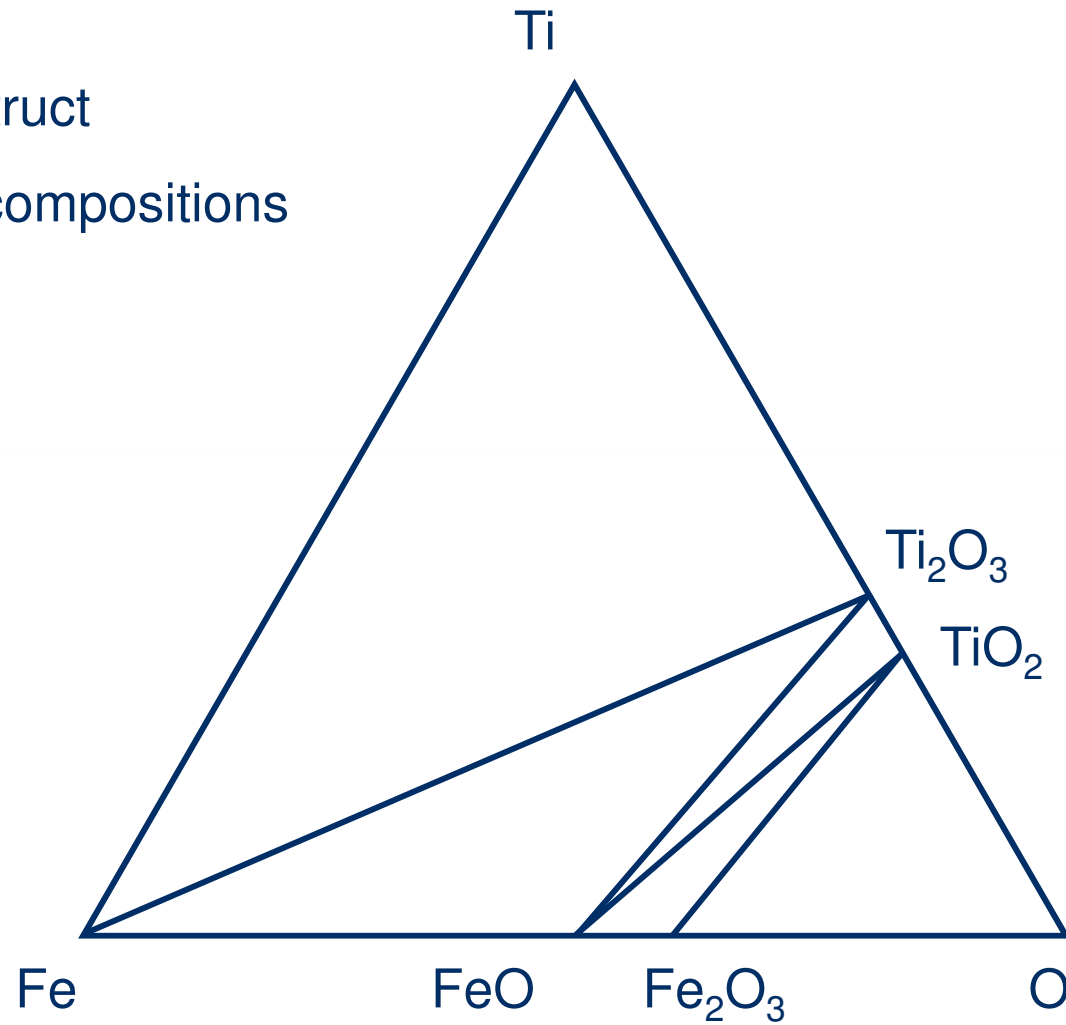


$M_3O_5(ss)$: ferrous-ferric pseudobrookite

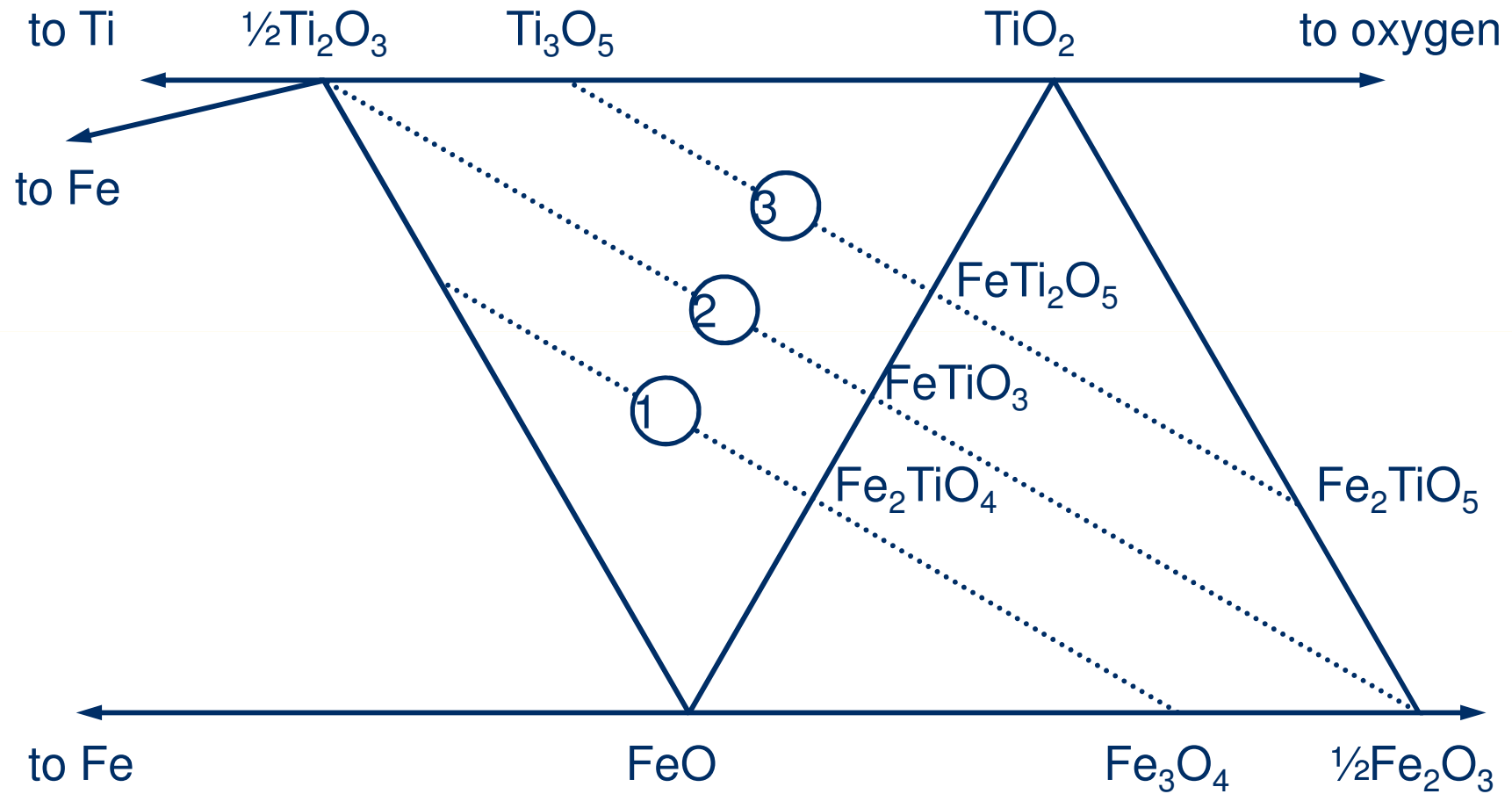
- iron
- titanium
- oxygen



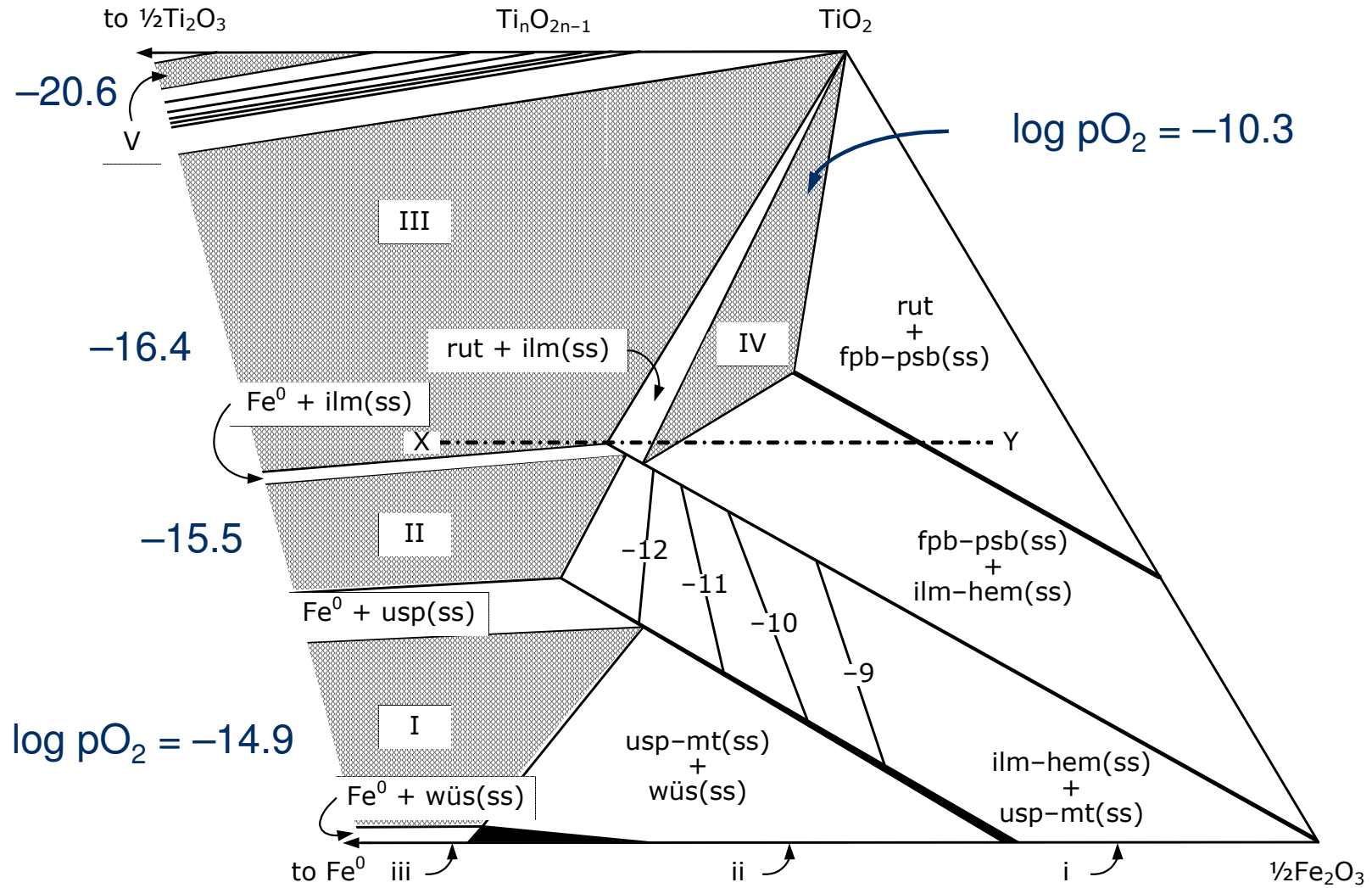
- A construct
- Molar compositions



Fe-Ti-O coordinates



Phase diagram for 1000°C



Driving forces at 1000°C

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
H ₂	—	—	—	15	—	—	—
H ₂ O	—	20	47.5	20	—	79	—
CO	—	—	47.5	—	15	3	—
CO ₂	—	—	—	—	20	17	—
CH ₄	95	15	—	—	—	1	—
N ₂	—	65	—	65	65	—	95
O ₂	5	—	5	—	—	—	5
log pO ₂	-27.3	-16.6	-16.2	-14.3	-13.7	-12.2	-1.3

Reduction and oxidation at 1000°C

