

IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

IRSN Proposition for Task 4 of the ISTC PRECOS Programme

M. Barrachin, M. Cranga, C. Mun

ISTC PRECOS Meeting at St Petersburg

7th-8th June 2011

MCCI : Already Investigated Compositions in the Past

Siliceous concrete-corium comp. with iron oxides (in wt.%)

	UO ₂	ZrO ₂	SiO ₂	CaO	FeO	Cr ₂ O ₃	Al ₂ O ₃
E2	33.8	14.5	14.1	-	30.1	7.5	-
C1	53.0	18.6	12.9	3.8	7.8	1.9	2.0

	T_{sol}^{mes} (K)	T_{liq}^{mes} (K)	
E2	1633-1673	1873-1913	[Hellmann et al., 2003]
C1	1477(*)	2463-2523	[Corphad, 2006], DTA & VPA

Comparison with NUCLEA

	T_{sol}^{E2} (K)	T_{liq}^{E2} (K)	T_{sol}^{C1} (K)	T_{liq}^{C1} (K)
NUCLEA05	1360	2180	-	-
NUCLEA06	-	-	1350	2290
NUCLEA10	1440	2120	1380	2300
Δ	-190	+210	-90	-160

⇒ Large discrepancies : among the suspected causes, Cr₂O₃ impact badly known,

⇒ UO₂-FeO-CaO and UO₂-FeO-SiO₂ not modelled (expected PRECOS results).

Criteria for the Choice of the Proposed Composition

- ▶ the composition should not include Cr_2O_3 because there are lacks of experimental data in the binary systems including this oxide (no experimental actions in the very next future),
- ▶ the composition should be complementary with the experimental efforts done in the $\text{UO}_2\text{-FeO-CaO}$ and $\text{UO}_2\text{-FeO-SiO}_2$ in PRECOS : the future measurements should help to check the extrapolation of the modelling of the binary and ternary systems (when done),
- ▶ the composition should be complementary with the already investigated compositions,
- ▶ the measured liquidus/solidus could be a direct support to a better understanding of a MCCI test.

Proposed Composition

Estimation of the composition at the end of the VULCANO VBU7 test (wt.%)

- ▶ from the volume of the ablated cavity (15 L),
- ▶ from the density of the concrete (2600 kg/m³),
⇒ ≈ 37 kg concrete,
- ▶ from the composition of the siliceous concrete,
- ▶ from the initial charge of the corium ≈ 54 kg.
⇒ MCCI composition : 40.8 concrete/59.2 corium in wt.%.

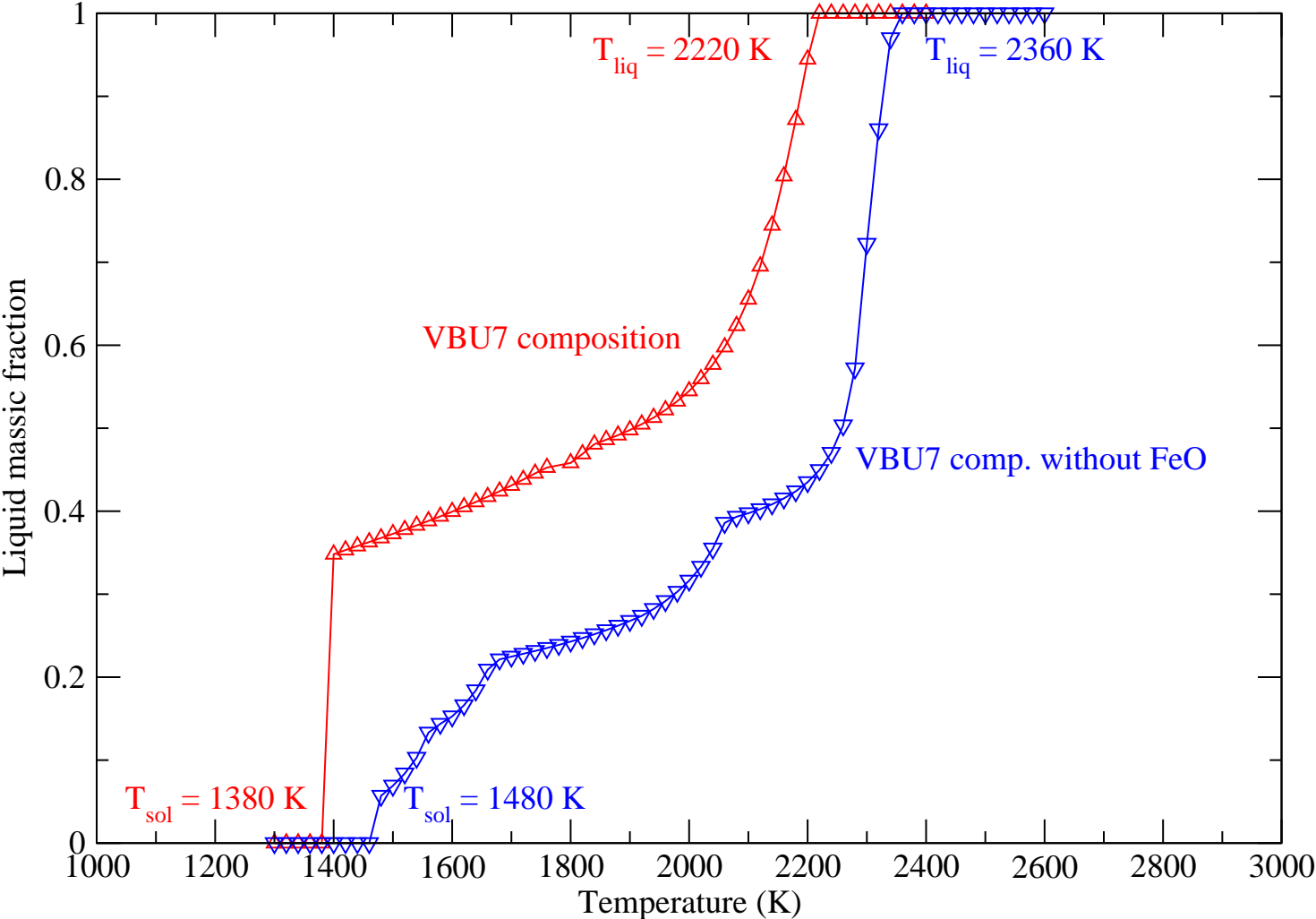
	UO ₂	ZrO ₂	SiO ₂	CaO	FeO	MgO	Al ₂ O ₃
VBU7	33.5	21.2	22.2	6.0	15.6	0.1	1.4

VBU7 composition allows to quantify the impact of FeO on a composition in the past investigated by Roche (1993)

	UO ₂	ZrO ₂	SiO ₂	CaO	Others
Roche	56.5	16.0	21.5	4.1	0.7

- ▶ exp. solidus 1400-1600 K, liquidus 2350-2550 K

Liquefaction Curve : Calculated Solidus and Liquidus for the Proposed Composition



Phases at Equilibrium for the Proposed Composition

