Tranquillityite \( \text{Fe}^{2+}_8 (\text{Zr}, \text{Y})_2 \text{Ti}_3 \text{Si}_3 \text{O}_{24} \)  

Crystal Data: Hexagonal.  
Point Group: n.d.  
As thin laths, to 65 \( \mu \)m, and as sheaves of laths.  

Physical Properties:  
Hardness = n.d.  
\( D(\text{meas.}) = \text{n.d.} \)  
\( D(\text{calc.}) = 4.7(1) \)  

Optical Properties:  
Opaque to semitransparent.  
Color: Gray; foxy-red [deep reddish brown] in strong transmitted light.  
Optical Class: Isotropic to weakly anisotropic.  
\( n = 2.11-2.13 \)  

Cell Data:  
Space Group: n.d.  
\( a = 11.69(5) \)  
\( c = 22.25(10) \)  
\( Z = 3 \)  

X-ray Powder Pattern:  
Sea of Tranquillity, Moon.  
3.23 (100), 1.781 (70), 2.155 (60), 4.04 (50), 3.34 (40), 3.18 (40), 3.13 (40)  

Chemistry:  
\[
\begin{array}{|c|c|}
\hline
\text{SiO}_2 & 14.00 \\
\text{TiO}_2 & 19.45 \\
\text{ZrO}_2 & 17.15 \\
\text{HfO}_2 & 0.17 \\
\text{Al}_2\text{O}_3 & 1.12 \\
\text{Cr}_2\text{O}_3 & 0.11 \\
\text{Nb}_2\text{O}_3 & 0.33 \\
\text{Y}_2\text{O}_3 & 2.76 \\
\text{Nd}_2\text{O}_3 & 0.24 \\
\text{FeO} & 42.48 \\
\text{MnO} & 0.29 \\
\text{CaO} & 1.26 \\
\hline
\text{Total} & [99.36] \\
\end{array}
\]

(1) Sea of Tranquillity, Moon; by electron microprobe, average of 12 analyses, original total given as 99.32\%; corresponds to \( (\text{Fe}_{7.36}\text{Ca}_{0.28}\text{Ti}_{0.25}\text{Mn}_{0.05})_{\Sigma=7.94}(\text{Zr}_{1.78}\text{Y}_{0.30}\text{Nd}_{0.02}\text{Hf}_{0.01})_{\Sigma=2.06} \) \( (\text{Ti}_{2.78}\text{Al}_{0.17}\text{Nb}_{0.03}\text{Cr}_{0.02})_{\Sigma=3.00}(\text{Si}_{2.90}\text{Al}_{0.10})_{\Sigma=3.00}\text{O}_{24} \).  

Occurrence: A late-stage crystallization product of lunar basaltic magma.  

Association: Troilite, pyroxferroite, tridymite, cristobalite, alkalic feldspar, felsic glass.  

Distribution: On the Moon, at the Apollo 11, 12, 14, 16, and 17 collection sites.  

Name: For the Sea of Tranquillity, Moon, from which the mineral was first collected.  

Type Material: Lunar Science Institute, Houston, Texas, USA.  

References:  
(2) (1973) Amer. Mineral., 58, 140–141 (abs. ref. 1).