



Elemental characterization of quartzite of Pouma-Cameroon: radiation attenuation properties based on NIST and GEANT4 simulation

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Introduction

The use of special rocks as building materials is growing in many developing countries. Quartzite of Pouma are widely exploited and used in Cameroon. The use of such rocks by the population and end-users can pose health problem if not well monitored. That is why it is vital to investigate its physical, radiological, and chemical properties to ensure their safe use.

Materials and Methods

❖ Sample collection & preparation

A total of 19 rocks samples were collected from four mining sites in Pouma-Cameroon



Fig. 1. Picture of collected and prepared samples.

❖ Sample analysis

The EDXRF from AMETEK, SPECTRO XEPOS version 5, equipped with a Pd/Co X-ray tube (50 KV, 2mA, 50 Watts) and a silicon detector of the vitus 3 cube type was used to analyze rock samples.



Fig. 2. EDXRF spectrometer used.

❖ Theory & Simulation

$$I = I_0 e^{-\mu x} \quad (1)$$

$$\frac{\mu}{\rho} = -\frac{1}{\rho d} \ln \left(\frac{I}{I_0} \right) \quad (2)$$

- XCOM program online
- GEANT4 toolkit

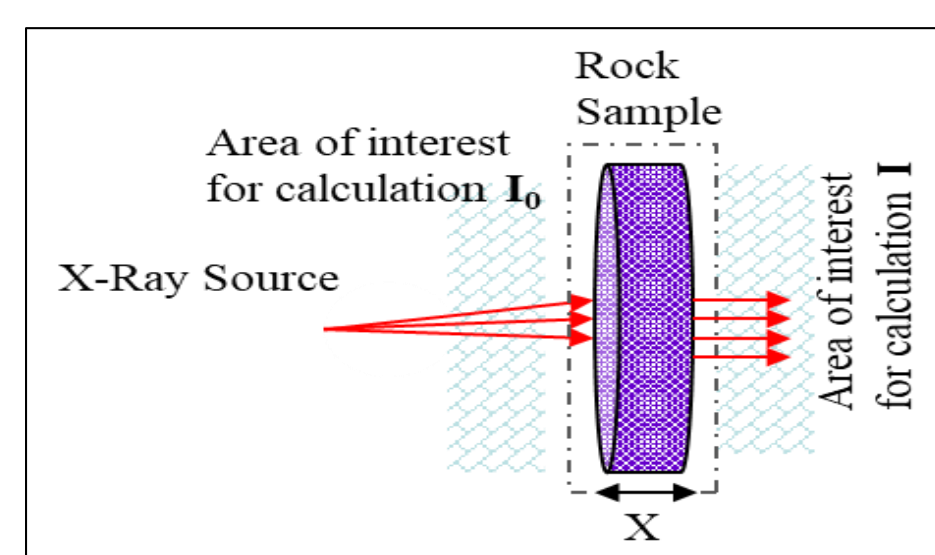


Fig. 3. Geometry used in GEANT4

Results and Discussion

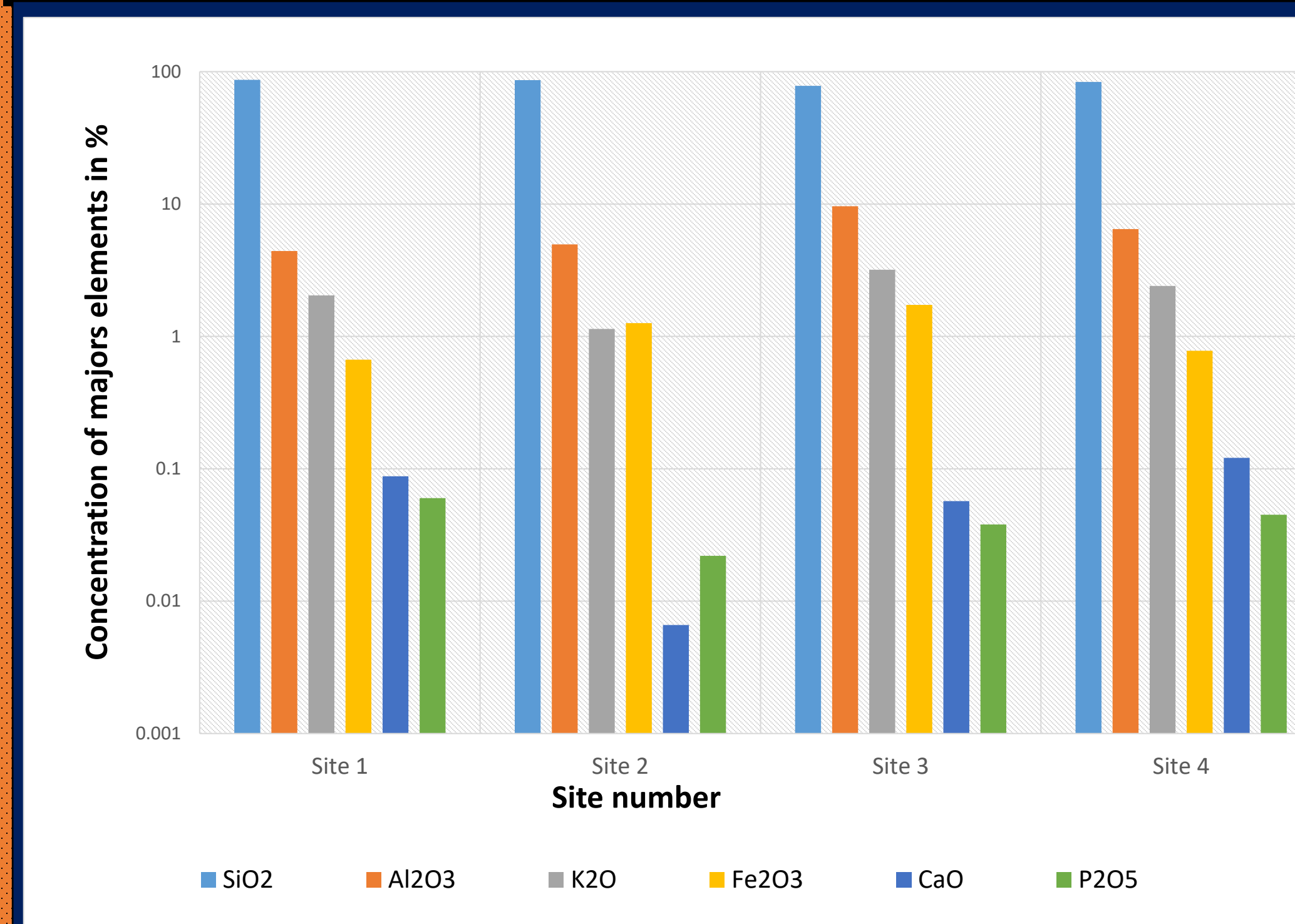


Fig. 4. Comparison of concentration (aver.) of majors elements present in the investigated rock samples from different sites.

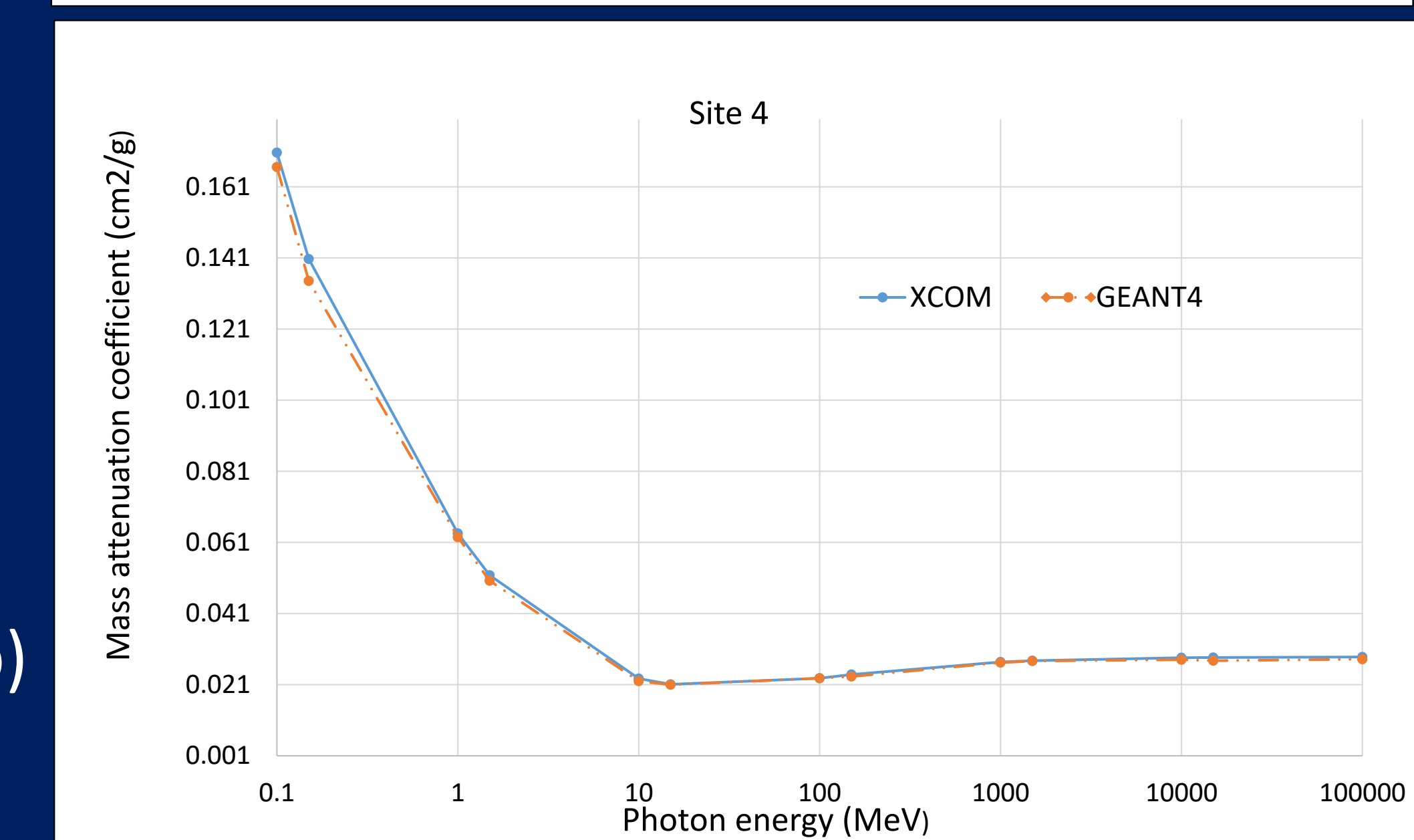
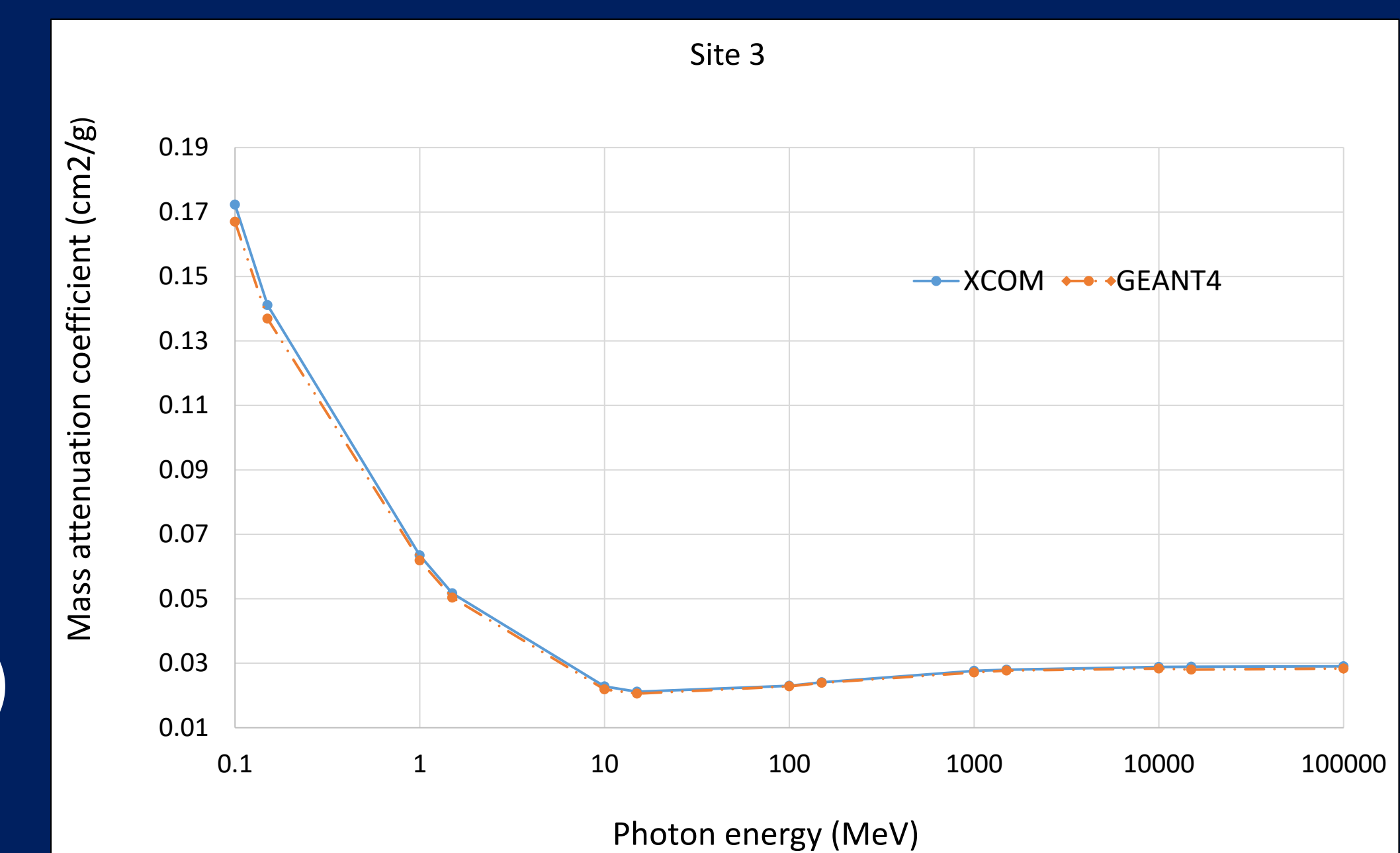
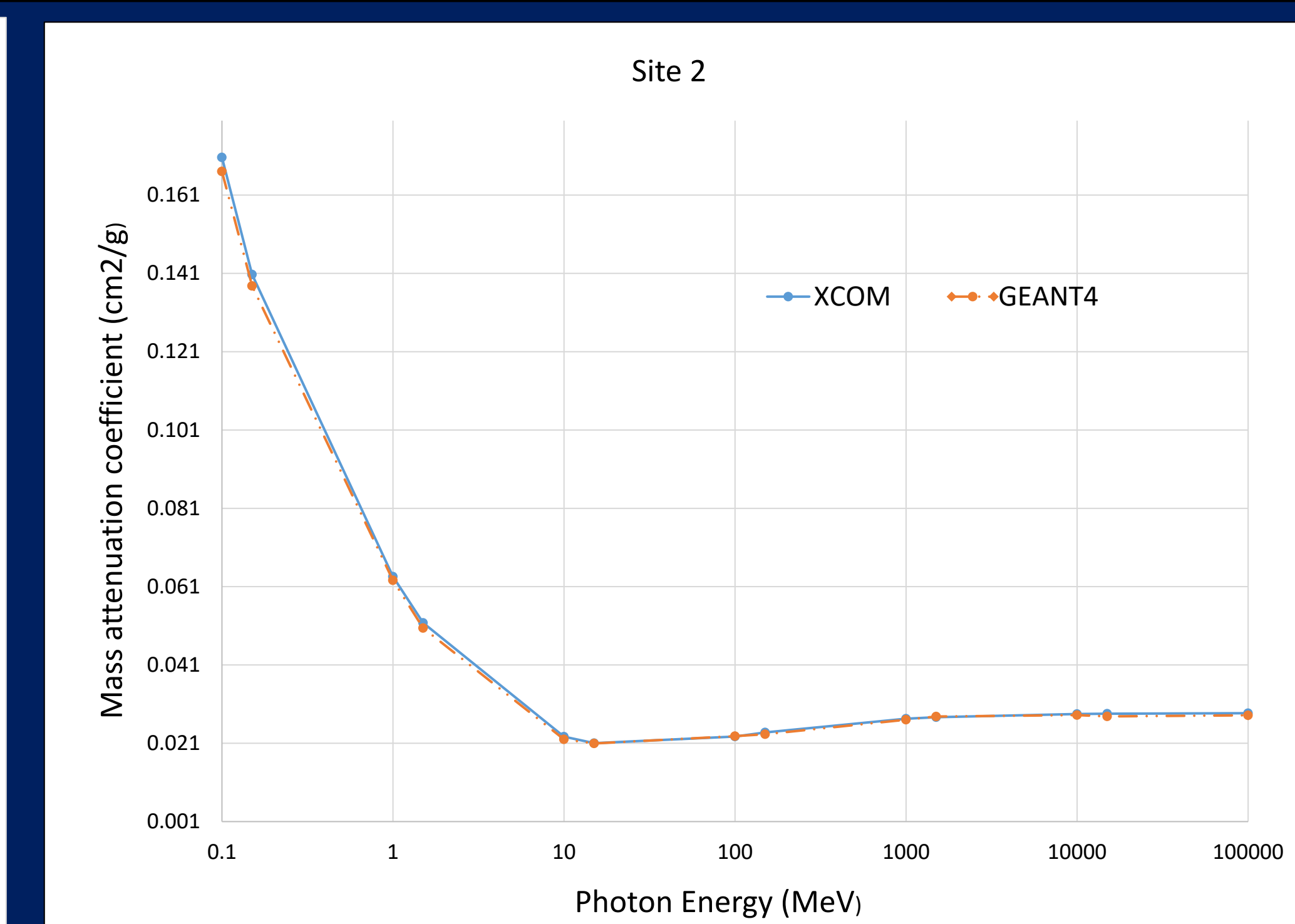
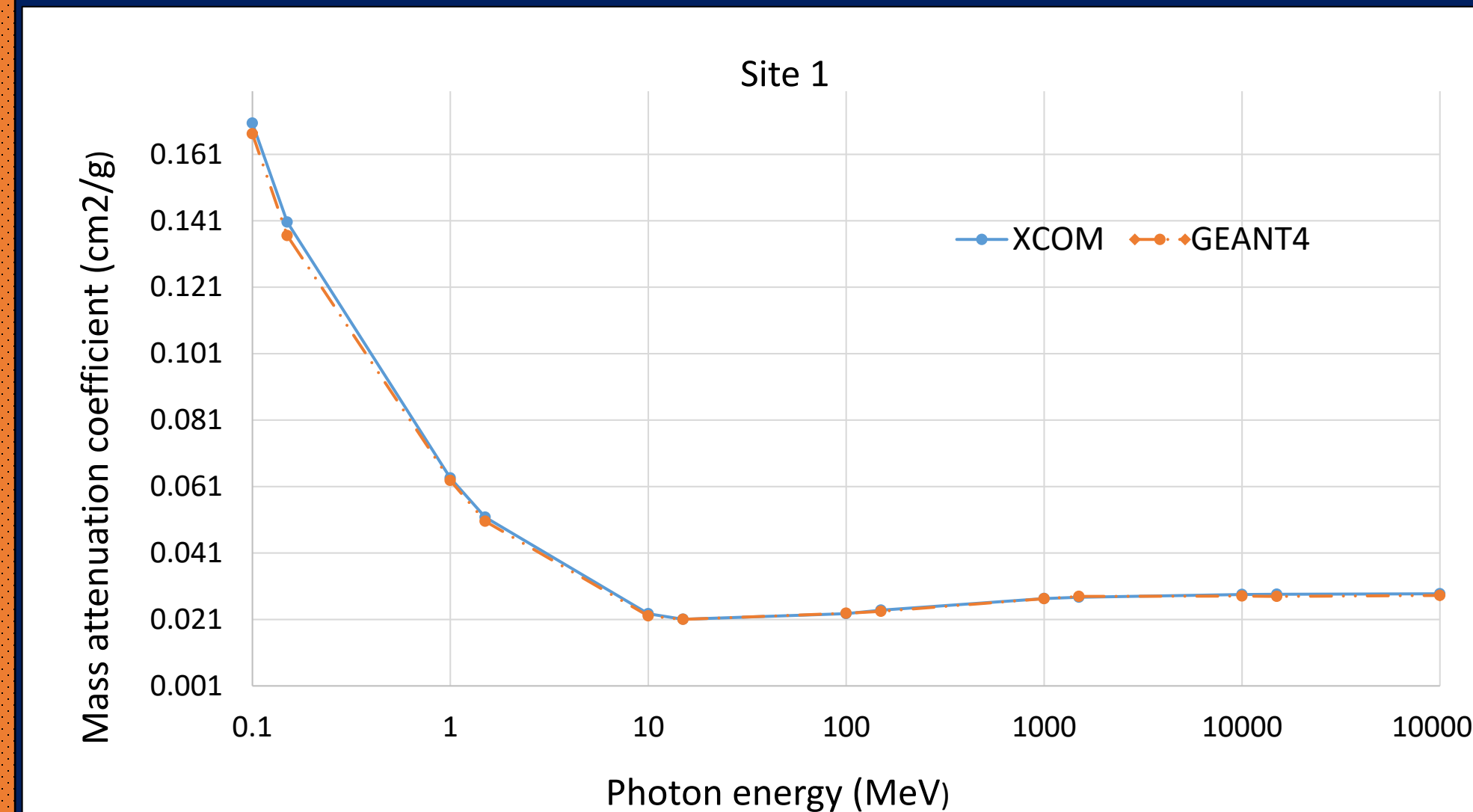
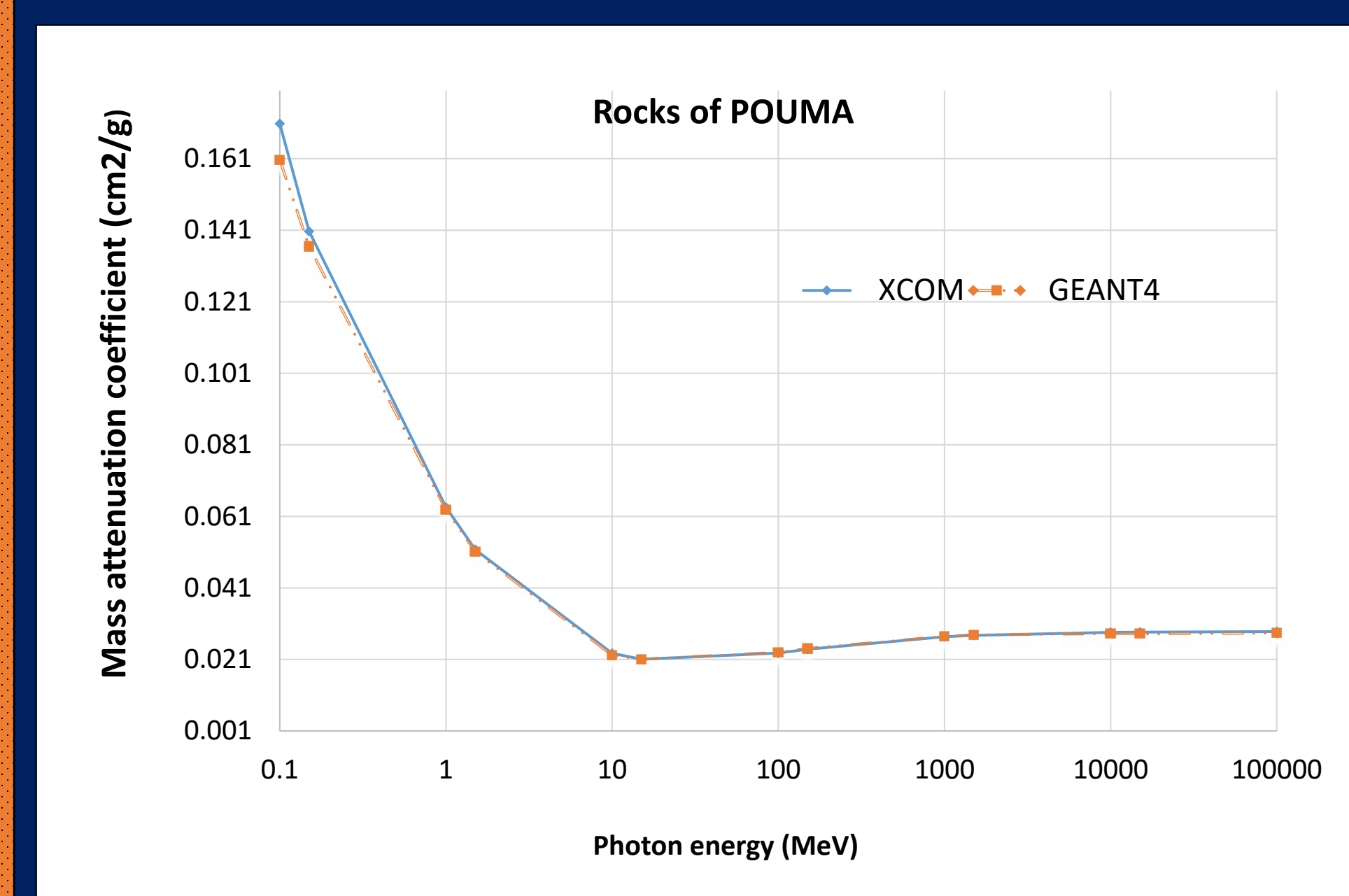


Fig. 5. (a-e): Mass attenuation coefficient of rock samples from different sites and the average by XCOM and GEANT4.

Conclusion

This study provides elemental characterization of rock samples from Pouma-Cameroon. It emerges from the obtained result that they are mainly composed of SiO₂, Al₂O₃, K₂O, Fe₂O₃, CaO, and P₂O₅. The majors component are used to compute mass attenuation coefficient-based XCOM program and GEANT4 toolkit. The calculations of mass attenuations coefficient reveal that the rocks of Pouma are can be used as decorative building material while they are appropriate to shield cosmic radiation. The obtained results showed good agreement between GEANT4 simulation and XCOM analytical method, proving that Monte Carlo method is an appropriate tool to be used for shielding calculations.

Acknowledgements

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