Mineralogical and Chemical Characterizations of Natural Clays from NW Cameroon

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MOTIVATION

For over three decades, Cameroonian researchers are interested in clay materials. Most of these researches have being dealing with 1:1clay type (mainly kaolinite) and talc. These clay materials have been thoroughly study in the framework of ceramic applications. Little work has been so far done on 2:1 type clays. Our focus in this study is to identify and characterize some of the 2:1 type deposits of Cameroon and to propose some potential application fields.

GEOGRAPHICAL & GEOLOGICAL SETTING

Cameroon: Central – Africa

Sabga is a locality situated in the Northwest region of Cameroon

Geological setting:

The area of study is part of the Bamenda mountains belonging to the Cameroonian volcanic line. It is located between the Bambouto mountains in the Southwest and the Oku massif in the Northeast. This volcanic provence is made up of mafic and felsic rocks emplaced on a panafrican line (Fig 1.)

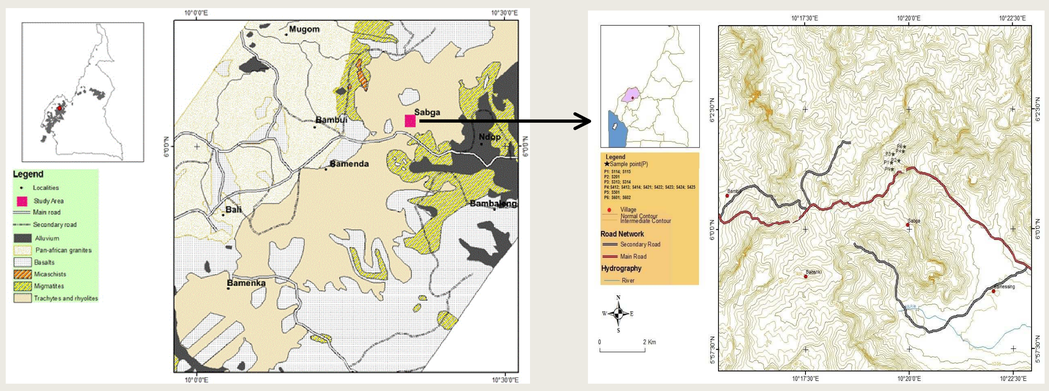


Fig 1.Geological map of study area (Modified from Kamgang et al., 2008) and location samples

ANALYTICAL METHODS

- X-ray diffraction (Powder (<250µm) and Clay fraction (<2µm)): for mineralogical composition
- Thermogravimetry (TG) and derivated thermogravimetry (DTG)
- Scanning electron microscopy: morphology and phase identification
- Energy dispersive X-ray spectrometry
- Nitrogen adsorption – desorption isotherm (BET): for specific surface determination and pores sizing
- Cation exchange capacity (CEC): by saturation of the clay fraction < 63µm with ammonium acetate as an exchangeable ion
- Particle size distribution
- Chemical composition: using ICP-MS

RESULTS

1. XRD

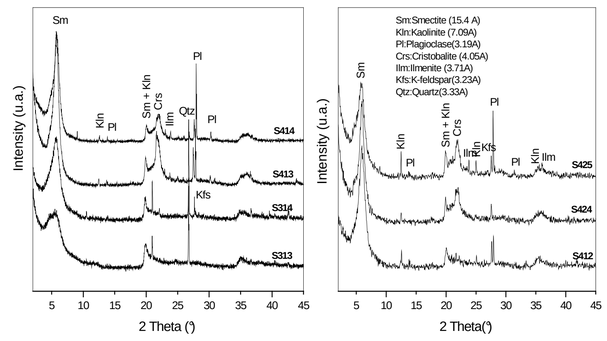


Fig 2. XRD patterns of the natural samples

The main clay minerals are smectites with kaolinite; the non clay minerals are cristobalite, k-feldspars, plagioclase, ilmenite and quartz.

Smectite : montmorillonite

2. Thermal behaviour

The large endothermic peak between 75-121°C and the corresponding mass loss is due to elimination of adsorbed water within interlayer and at the clay surface, the release of water due to the dehydroxylation of coordinated and structural water molecule is observed between 450-465°C. The peak that occurred at arround 635°C is characteristic of smectite dehydroxylation.

The mass loss value is ranged between 3 – 10%.

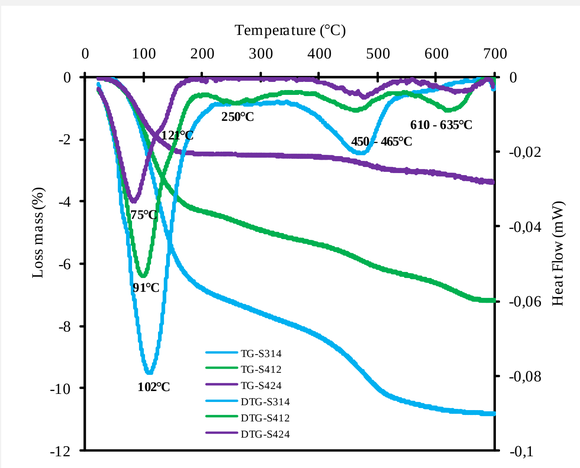


Fig.3. Thermograms of the natural clays

3.Physico-chemical characterizations

Particle size distribution: Clay (< 2µm): 3- 29%; Silt (2-50µm): 37- 59%; Sand (Fine: 50 – 200µm): 20 – 42%; Sand (Coarse: 200 – 2000 µm): 11 – 14%

- **pH**: 4.1- 5.1
- **CEC**: The clay samples have a cation exchange capacity between 24.2 - 62.0 meq/100g (measured by saturing the clay fraction < 63µm with ammonium acetate as an exchangeable ion)
- **Specific surface area (S_{SA})**: 58 to 123 m^2/g

- **Chemical composition**

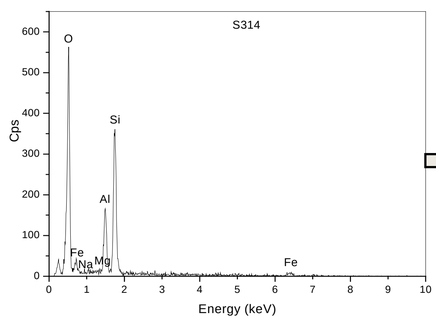
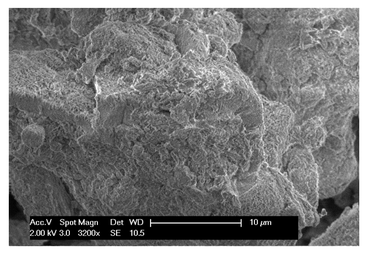


Fig.4. EDX analysis spectrum of S314

Elements	Mass (%)	At (%)
Ok	36.78	53.63
Nak	0.97	0.98
Mgk	0.82	0.79
Alk	12.37	10.70
Sik	32.46	26.96
Fek	16.60	6.94
Total	100.00	100.00

- **SEM micrograph of S413**



Potential Applications:

These clay minerals can found in their application:

- Industry refining of edible vegetable oils;
- The storage of pollutants (heavy metals, radioactive waste);
- Agriculture and others.

CONCLUSION

The results of this investigation show that the clay samples from Sabga (NW Cameroon), mainly consist of smectite with varying amounts of kaolinite, cristobalite, k-feldspar, plagioclase and ilmenite. The Greene-Kelly test show that the smectite are montmorillonite. These smectite-rich materials which can be valued in areas such as absorption, agriculture or agronomy and storage of waste (soil sealing).

References:

1. Kamgang, P., Njonfang, E., Chazot, G., Njonfang, E. and Tchoua, F(2008). Geochemistry and geochronology of mafic rocks from Bamenda Mountains (Cameroon): Souce composition and crustal contamination along the Cameroon Volcanic Line. C.R. Geosciences, 340, 850-857.