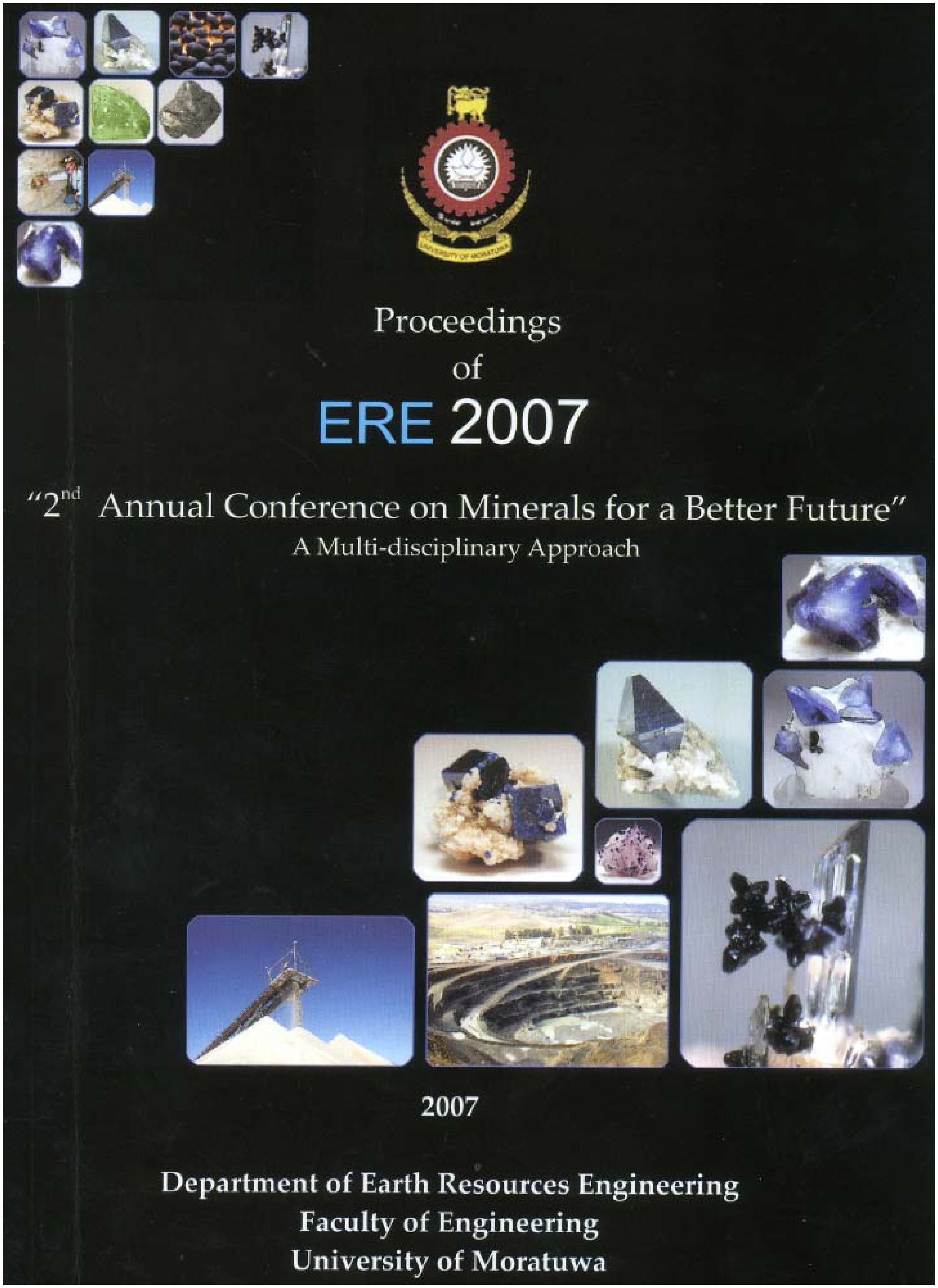
EXTENDED ABSTRACTS (Peer Reviewed)

Amaraweera, T.H.N.G., Pitawala, H.M.T.G.A. and **Fernando, G.W.A.R.** (2007) Stability of Mica, K-Feldspar and Apatite in Water, Organic Matters and Citric Acid, *Proceeding of the 2nd Earth Resource Engineering Conference (ERE 2007), Colombo, November 2, 2007, pp.25-28*



Afternoon session

Chair person - Dr. Vasantha Siriwardhana -Environmental Engineering Consultant - EML Consultants Pvt. Ltd

Theme - Mining and Mineral industry Vs Environmental protection in Sri Lanka; are we ready for the future challenges?

13.30 – 13.40	Nutrients, Fe and Bacterial Removal in Sub Surface Flow Constructed Wetlands Treating Polluted Mine Water - Dharmasiri KLGNC, Yalini A, Jeewantha DLC and Karunarathne S
13.40 – 13.50	Alternative for River Sand - Ekanayaka EMTM, Jayawardene MN, Kannangara KKDM, Puswewala UGA, Rathnayake NP, Chaminda SP and Vijitha AVP
14.50 – 15.00	Ground Vibration and Air Blast Overpressure Assessment using Scaled Distance - Sivarajan V, Kumara KLDS, Hearath HMSD, Nanayakare NWP, Walideniya HS and Weerawarnakula S
15.00 – 15.10	Stability of Mica, K-Feldspar and Apatite in Water, Organic Matters and Citric Acid - Amaraweera THNG, Pitawala HMTGA and Fernando GWAR
15.10 – 15.30	Discussion
15.30 – 15.45	**Tea break**

Evening Session

Chair person - Mr. Athula Mudunkotuwa - Deputy Director-Geology- Geological Survey and Mines Bureau

Theme - Legislation for mineral exploration and extraction; Do we have to rethink?

15.45 – 15.55	Rheological Behaviour of Mineral (Clay) Suspensions - Balasooriya BARD, Kumara WC, Prasanna TGS, Sasekaran M and Fernando WLW
15.55 – 16.05	The Use of Prototype Pelletizer for Iron Ore Preparation - Arachchi GARMG, Jayarathna STCK, Jeyarupan G, Thusyanth M and Fernando WLW
16.05 – 16.15	Cost estimation and Development of Cash Flow on Mining Operation (IML/A category quarry operation) - Amirthasothy V, Arulvadivel T, Fareez MRM, Kommala KD, Madanayake TA, Walideniya HS and Weerawarnakula S
16.15 – 16.25	Recovery Enhancement of Graphite Tub-dust to 99+ Carbon using a Mill Modification - Samarakkody SATI, Rohitha LPS and Fernando WLW
16.25 – 16.45	A Pilot Study on the Mineralogical and Geochemical Characteristics of a Recently Discovered In-Situ Beryl Occurrence at Kaltota, South Central Sri Lanka - De Silva PJS, Kuhananthan P, Consalas MA, Nazlan MZM, Aflal MCM, Abeysinghe AMKB, Rathnayake NP, Weerawarnakula S, Premasiri HMR and Siriwardana CHER
16.45 – 17.00	Discussion
17.00–17.30	Closing Ceremony and vote of thanks

Stability of Mica, K-Feldspar and Apatite in Water, Organic Matters and Citric Acid

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Abstract: The short term stability of mica, feldspar and apatite in different geochemical conditions were tested in the laboratory. Different proportions of powdered minerals (<125 μm) were mixed with organic matter with water, water and 2% citric acid. The mixtures were kept under room conditions, using controlled moisture content. The water soluble ionic concentrations of each mixture were measured and their variations with the time were studied. The study revealed that the dissolution of minerals is controlled by mineralogical characteristics of them and the chemical nature of solutions. Both mica and feldspar release higher amounts of potassium compared to other ions when they are in water or in moist organic matter. Feldspar is stable whereas mica and apatite are significantly unstable in the citric acid. However, mica released considerably higher amount of iron in the acidic media (pH-2-3). The dissolution of apatite and K-feldspar is low when mineral mixtures contain biotite. Biotite mica and apatite have high potential to use as fertilizers for crops growing in acidic soils.

Keywords: Dissolution, Fertilizer, Mineral Stability

1. Introduction

Mineralogical characteristics and biogeochemical processes taking place in the nature are key factors that control the chemical weathering process of rocks and minerals, which lead to release of ions from stable minerals. Most of liberated ions from such processes are essential nutrients for plants (Weerasuriya etal., 1992). Therefore, the present study focuses on the short term stability of some nutrients enriched minerals such as mica, feldspar and apatite under different geochemical conditions in order to (1) identify the least stable mineral, (2) estimate the possible potential of them to be used as fertilizers and (3) to understand the effect of minerals on the stability of other mixtures.

2. Material and Methods

Potassium feldspars and biotite from waste dumping sites of pegmatite bodies at Owala – Kaikawala, Matale and apatite crystals from Eppawala were powdered. The finer fraction less than 125 μm was separated by sieving. Different proportions of mineral powder were mixed with; (1) organic matter (cowdung), (2) water and (3) 2% citric acid (Table 1).

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Different mixtures of mineral powder were kept for decomposition under controlled moisture content at room temperature. One gram (1g) of each mixture of minerals and organic maters was shaken with 100ml water for 30 minutes to obtain water soluble ions. The released ions from minerals solved in water or in 2% percent citric acid were also measured by directly analysing the solution. The dissolved ions such as K, Ca, Mg, Mn, and Fe were measured using atomic absorption spectrophotometer (AAS- Perkin-Elmer 2380) at the Department of Geology, University of Peradeniya.

3. Results

3.1 Minerals Mixed with Organic Matters

The dissolved ionic concentrations of every sample increased with time up to 60 to 90 days, and thereafter the concentrations fluctuated with time (Figures 1 & 2). However, the releasing rate of both K and Na is the same. In contrast, liberation of Mg and Ca from minerals shows a different pattern over the time. The releasing of Fe is not systematic and fluctuates between 0.01 to 1.5 ppm up to 180 days. However, a rapid increment of release of Fe occurred in all mixtures. However, Mn released by minerals was not significant (0-0.02ppm). Highest concentration of K is released by the organic matter into water and the release of K by minerals themselves into water was not significant (Figs.1- 3). Biotite releases more K than feldspars. Releasing of K by feldspar reaches the maximum level after 30 days and the rate of releasing of K is constant over the time.

3.2 Minerals Immersed in Water

Release of Ca and Mg is constant over the time when mixtures do not contain apatite. However, Ca levels fluctuated rapidly between 10 to 40 ppm in the mixtures containing apatite (Figure 3).

Table 1: Extents of Mineral/Mineral Mixtures and Treatments Methods

Sample No	Media - weight/volume	Weight of Mineral (g)		
		Fld	Bt	Ap
MT01	Organic	-	-	-
MT02	Matter	150	-	-
MT03	600 grams	-	150	-
MT04		-	-	150
MT05		150	150	-
MT06		150	-	150
MT07		-	150	150
MT08		200	200	100
MT09		150	_	150
MT10		-	150	150
MT11	Water	-	-	-
MT12	500 ml	100	-	-
MT13		-	100	-
MT14		-	-	100
MT15		100	100	-
MT16		100	-	100
MT17		-	100	100
MT18		50	50	25
MT19		50	-	50
MT20		-	50	50
MT21	2% Citric	-	-	-
MT22	Acid	10	-	-
MT23	100 ml	-	10	
MT24		-	-	10
MT25		10	10	-
MT26		10	-	10
MT27		-	10	10
MT28		5	5	2.5
MT29		2.5	-	2.5
MT30		-	2.5	2.5

Fld = Feldspar, Bt= Biotite, Ap= Apatite

Mg concentration was between 0.1 to 5 ppm. Biotite releases more Fe (0.0-25 ppm) than the feldspar (0.5-2.5 ppm) and apatite (0.2-5ppm). Release of Na from minerals into water reached maximum levels after 120 days (Figure 4).

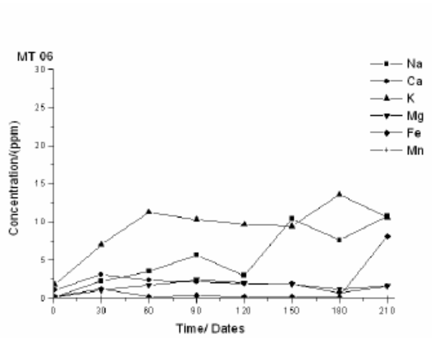

Figure 1. Ions released after treated with 5(organic matter): 1(feldspars): 1(apatite)

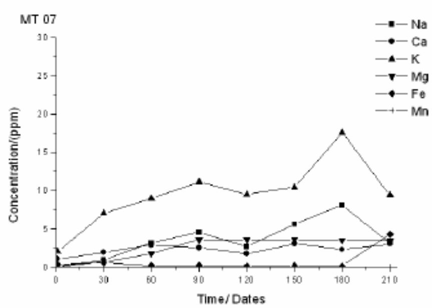

Figure 2. Ions released after treated with 5(organic matter) : 1(biotite) : (1) apatite

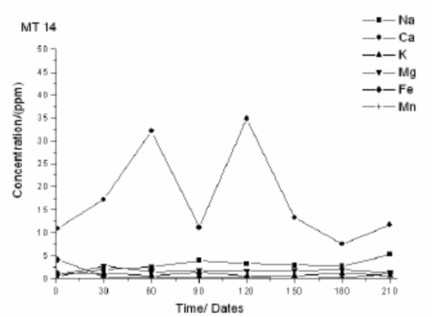

Figure 3. Ions released by apatite (100 g) into water (500 ml)

3.3 Minerals Immersed in Citric Acid

Release of ions from the minerals and mineral-mixtures is considerably high when they were treated with the acidic (pH=2-3) media (Figure 5). Results showed that the biotite releases higher concentrations of K than the feldspar. Release of K from samples reached to a maximum level within 30 to 90 days. The concentration of Mg, Na and Mn are almost constant over the time. Apatite releases higher level of Ca than other minerals (Figure 6). Ca concentration in this medium rapidly went down after 30 days and the concentration fluctuated with a small range of low Ca concentrations. The Fe concentrations of biotite and biotite mixtures increase slowly until 120 days (Figure 7). However, a rapid increase of Fe levels was recorded after 120 days. Generally biotite released considerably higher concentrations of iron.

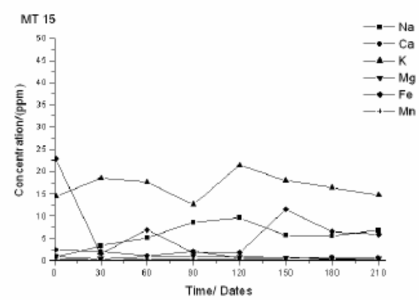

Figure 4. Ions released by the feldspars (100 g) and biotite (100 g) in to water (500 ml)

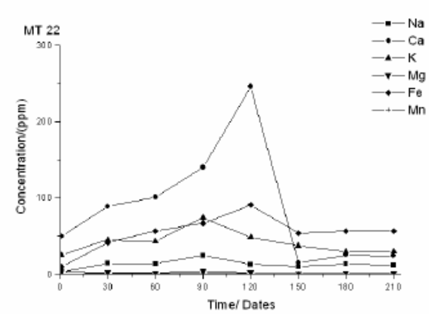

Figure 5. Ions released by the feldspars (10 g) into 2% citric acid (100 ml)

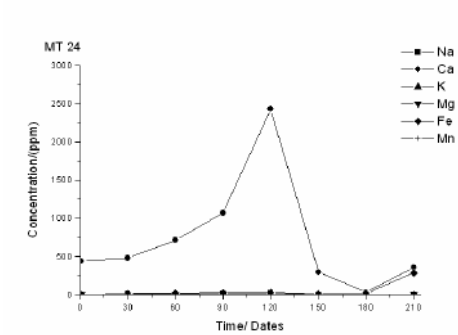

Figure 6. Ions released by the apatite (100 g) into citric acid (100 ml)

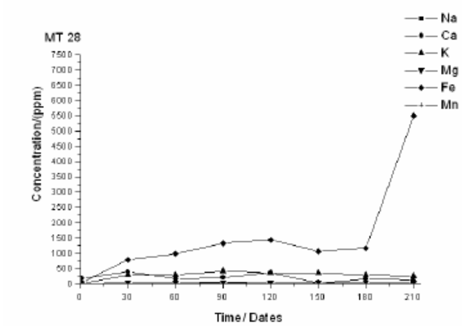

Figure 7. Ions released by the feldspars (5 g) + biotite (5 g) + apatite (2.5 g) in to citric acid (100 ml)

4. Discussion

The study revealed that the dissolution of minerals depend on the chemical and physical characteristics and the medium that used for the treatment. It was observed that the concentrations of available ions of minerals mixed with the organic matter are low. It may be due the attaching of released ions from minerals into the organic matter. Apatite and mica were highly unstable in acidic conditions but feldspar was relatively stable in every system during the study period. Samples with biotite released higher concentrations of many ions into the used medium as the interlayer ions in mica can easily leached out from its structure. The next unstable mineral is apatite, especially under acidic conditions. In the acidic media, mica releases considerably higher amount of Fe and it may effect the concentrations of dissolved ions in the system. Lower concentrations of Ca in apaite-mica mixtures compared to apatite indicated that the mica effect on the dissolution of apatite.

As biotite and apatite is unstable under acidic conditions, it can be suggested that both mica and apatite can be used as fertilizers for long term crops growing on acidic soils. However, the use of K-feldspar will not be a useful mineral fertilizer as it is not stable under every condition.

5. Conclusions

Rate of biogeochemical processes occurring in the natural systems are very slow in releasing irons in to the systems by the minerals. Dissolution of minerals is controlled by their mineralogical characteristics and the chemical nature of solutions.

As organic matter can absorb leached out ions from minerals, the concentrations of free ions in mineral-organic matter mixtures are low. Biotite mica and apatite are highly sensitive to acidic environments but K-feldspar is comparatively stable under such conditions. The dissolution of apatite and K-feldspar is low when mineral mixtures contain biotite. Biotite mica and apatite have high potential to be used as fertilizers for crops growing in acidic soils.

Acknowledgement

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References

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