be noted that the plagioclase-clinopyroxene-olivine thermal barrier, often separating the fields of saturated and undersaturated basalts, appears not to have prevented siliceous differentiates being derived from the more undersaturated representatives of the Albert Basalt. This is probably due to some of the formation's basaltic magmas passing from the undersaturated to saturated field at $P \geqslant 20$ kb.[5] (*i.e.*, at a depth approximately $\leqslant 65$ km) where the thermal barrier is inoperative.

In summary then Sr isotopic evidence has been useful in studies of the petrogenetic history of the Focal Peak Shield Volcano in which the Mt. Gillies Rhyolite is believed to be a strongly fractionated differentiate of the alkaline Albert Basalt. Halts in transportation of the differentiating magmas towards the earth's surface is believed to be of great importance in the petrogenesis of the rhyolitic formation.

TABLE I

*$Sr_i^{87/86}$ ratios for the Albert Basalt**

Sample No.**	Rock Type	$Sr_i^{87/86}$
33,063	Hawaiite	0·7067
33,065	Mugearite	0·7042
33,066	Alkali olivine basalt	0·7045

* $Sr_i^{87/86}$ has been calculated on the basis of a late Oligocene age[1].

** Sample numbers are for the University of Queensland, Department of Geology and Mineralogy Rock Catalogue.

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ON THE SIGNIFICANCE OF ENHANCED GLUTAMINE SYNTHETASE AND ITS REGULATION DURING AESTIVATION IN *PILA GLOBOSA*

In aestivating *Pila globosa* the protein content decreases and the general amino acid pool increases of which certain amino acids alone predominate[1]. Uric acid level increases[2,3] while urea content decreases[3] in all the tissues during aestivation indicating that the protein nitrogen is probably metabolized to uric acid during aestivation. However there are no reports on the activity levels of the enzymes concerned with the synthesis of uric acid during aestivation. The present report concerns the distribution and the activity of glutamine synthetase during aestivation, since this enzyme level determines the glutamine level which is known to contribute to N-3 and N-9 of the uric acid molecule.

Glutamine synthetase activity in the hepatopancreas, mantle and foot of the active and three months aestivated *Pila globosa* was estimated by the method of Iqbal and Wu[4].

It was observed that the synthesis of glutamine from glutamic acid is limited to hepatopancreas since the other two tissues, namely, mantle and foot had no detectable activity of the enzyme. Thus in mantle and foot the rate of glutamine synthesis is slowest thereby limiting uric acid biosynthesis. Such control mechanisms limiting the entire pathway by some slow steps in reaction sequences are not uncommon in animal biochemistry. The low level of this enzyme will be responsible for lower glutamate metabolism into glutamine thus resulting in accumulation of glutamate[1,5] reported during aestivating *Pila globosa*.

There is a 100% increase in the glutamine synthetase in hepatopancreas of the 30 days aestivating *Pila globosa* and the activity is maintained at that level even in 3 months aestivating snails. In active snails the ammonia produced in the metabolism is constantly excreted thereby averting the possible ammonia toxicity to the tissue metabolism. In the absence of such ammonia toxicity the α-ketoglutarate could have been metabolized without the necessity of being converted to glutamate. In the present investigation the aestivating snail, since the possibility of excretion is less, there is every danger of accumulation of ammonia to the level of lethality. To prevent this catastrophe the aestivating metabolism is geared to alternate stepping up of processes that knock out ammonia which could be as follows.

α-Ketoglutarate dehydrogenase complex was shown to be inhibited by $NADH_2$[13]. The increased cytoplasmic and mitochondrial $NADH_2$/NAD ratio have been roported in the liver of turtle and rat

TABLE 1

Glutamine synthetase activity in tissues of active and different periods of aestivated Pila globosa

Sl. No.	Tissues	Active	1 Month aestivated	2 Months aestivated	3 Months aestivated
1.	Foot	—	—	—	—
2.	Mantle	—	—	—	—
3.	Hepatopancreas	6·3±1·78	12·6±1·1 +100·00% $p > 0·001$	12·1±1·1 +92·6% $p > 0·001$	11·33±2·23 +79·86% $p > 0·001$

Note:
1. — : indicates activity below the level of detection.
2. ± : indicates standard deviation (S.D.).
3. +% : indicates per cent over active.
4. p — : level of significance.

during hypoxia[14-16]. Moreover, succinate dehydrogenase activity was reported to decrease in aestivation[11-12] indicating that the formation of succinate through α-ketoglutarate dehydrogenase complex is less. Under these conditions it is likely that the amination of the α-ketoglutarate by glutamate dehydrogenase is preferred to oxidation by α-ketoglutarate dehydrogenase. Increased glutamate dehydrogenase reported during aestivation[16] is consistent with the above inference. Glutamic acid is shown to be a potent inhibitor of the nervous system[17] and many enzyme systems in *Pila globosa*. Hence it is converted to less toxic glutamine.

The activity pattern of glutamine synthetase is modulated by adenylylation of the enzyme by ATP. This process is catalyzed by adenylyl transferase. The increase in the level of glutamine and ATP activate this enzyme which results in the elevated levels of glutamine synthetase-AMP complexes[7]. The adenylylation complex has low activity and consequently the formation of further glutamine is reduced[8,9]. Glutamine synthetase + 12 ATP

$$\underset{\text{transferase}}{\overset{\text{Adenyl}}{\rightleftharpoons}} \text{Adenylyl-glutamine synthetase} + 12\ \text{PPi}.$$

In the aestivated animal tissues ATP and glutamine levels were high[10] which under normal conditions activate adenylyl transferase, resulting in a decrease of glutamine synthetase activity. On the contrary, an increase in the activity of glutamine synthetase is observed in aestivated animal tissues indicating nonadenylylation of the enzyme possibly by the stepped up deadenylylation. α-Ketoglutarate and ammonia are known to activate deadenylylating systems[6]. This peculiar shift is probably for meeting the emergency survival demand against ammonia toxicity.

Thus in the aestivating *Pila globosa* though the conditions are favourable for adenylylation of glutamine synthetase as a consequence of high levels of ATP and glutamine adenylyl transferase is not active. Hence there is a shift in the pattern of enzyme regulation towards the activation of deadenylylating enzyme or insensitization of adenylylating system.

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