高寒草甸生态系统国际学术讨论会论文集 1988年10月
THE PROCEEDINGS OF THE INTERNATIONAL
SYMPOSIUM OF ALPINE MEADOW ECOSYSTEM Oct., 1988

高山草甸土壤有机氮矿化之研究

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近十年来，关于土壤有机氮矿化的研究报道不断增加．国内这类研究多集中于耕地(白志坚等,1981;王湧清等,1986),特别是水稻土(汪寅虎等，1983;朱兆良等,1984;高家骅等，1984),而对草地土壤有机氮矿化的研究，尚未见报道．在国外这方面的研究报道已屡见不鲜,研究不仅限于耕地,也包括草地土壤 (Smith 等,1971; Stanford 等，1972; Reuss 等,1977).

国内外研究结果表明：通过土壤有机氮矿化之研究,不仅可揭示出土壤供氮特性,为科学施肥(或估计植物生长)提供依据．而且为研究营养物质循环奠定基础．

高寒草甸植物所需的氮素主要来自土壤．而土壤中的氮素绝大部分以有机态存在．土壤中供植物生长吸收的速效氮,在颇大程度上是通过有机态氮的矿化而提供的．因此,该类土壤氮素矿化研究具有特殊意义．

一、材料与方法

供试土样于1984年5月采自海北高寒草甸生态系统定位站．土样系普通高山草甸土与高山灌丛草甸土．生长的主要植物分别为矮嵩草 (*Kobresia humilis*) 与金露梅 (*Dasiphora fruticosa*)．土样的基本性质列于表1．

表1 供试土壤的基本性质(烘干基)

Table 1 The characteristics of investigated soil samples (oven-dried basis).

亚类 Subtype	深度(厘米) Depth (cm)	pH	有机质(%) O. M.	全氮(%) Total N	C/N
普通高山草甸土 Ortho alpine soil	0—20	7.30	7.38	0.419	10.2
	10—20	7.70	7.18	0.392	10.6
	20—30	8.30	2.99	0.173	10.0
高山灌丛草甸土 Alpine shrub meadow soil	0—15	7.40	14.04	0.756	10.8
	15—30	7.70	9.83	0.478	11.9

土壤氮素矿化研究采用长期室内培养法：称取通过1毫米孔径的风干土样和0.5—1毫米的石英砂各10克,喷入少量蒸馏水混匀后,放入事先垫有纤维棉(0.2克)的平底渗漏管(直径为18毫米,长190毫米)中,然后在试样上盖一层纤维棉(0.1克),试样装好后,加

水经抽滤控制试样含水量为最大持水量的60%（高山草甸土试样含水量保持为35%，高山灌丛草甸土保持为60%）．渗漏管口用塑料薄膜加封，下端用上夹的乳胶管连接，在室温下预培2周后，用0.01*M*氯化钙100毫升淋洗，然后加25毫升无氮培养液淋洗并通过抽滤控制到上述含水量，弃去淋洗液．将渗漏管分别置于35℃、25℃与5℃培养箱中培养．培养周期分别于2、2、4、4、6、8、8周，每次按上述办法获得的淋洗液全部转入250毫升开氏瓶中，加德氏合金0.5克，无二氧化碳的氧化镁0.5克，然后蒸馏，用2.5%的硼酸吸收，0.005摩尔盐酸滴定，测定值为氨态氮与硝态氮之和．

二、结果与讨论

（一）矿化氮累计量

一定时间内(以周计)测定的矿化量之累计值为矿化氮累计量．现将测得的两种土壤于不同的培养时间、温度与层次的矿化氮累计量列于表2．

表2 高山草甸土在不同时间内氮素的矿化累计量

Table 2 Accumulation quantity of mineralization N in alpine meadow soil at different time (unit: ppm)

亚类 Subtype	深度(厘米) Depth (cm)	温度(℃) Temperature	2	4	8	12	18	26	34(周) (weeks)
			累计量 Accumulation quantity						
普通高山草甸土 Ortho alpine meadow soil	0—10	5	30.4	36.8	44.2	49.2	61.3	63.7	65.9
	10—20		20.8	26.3	31.1	33.6	40.1	41.1	42.6
	20—30		11.0	14.9	16.9	19.0	22.8	23.5	24.7
	0—10	25	36.7	64.9	126.2	174.3	241.4	248.9	256.2
	10—20		34.0	42.5	54.9	71.2	90.6	96.6	101.7
	20—30		21.6	27.3	34.6	39.7	45.6	51.7	56.6
	0—10	35	121.7	174.5	224.3	274.5	350.0	359.2	366.9
	10—20		60.0	90.8	106.3	129.2	165.0	170.9	176.5
	20—30		27.3	35.3	49.3	61.8	80.0	83.2	86.5
高山灌丛草甸土 Alpine shrub meadow soil	0—15	5	46.3	55.6	67.3	80.4	97.5	101.9	105.0
	15—30		23.9	32.2	37.6	45.8	50.5	51.6	52.8
	0—15	25	82.1	120.6	201.2	417.0	523.6	541.0	548.5
	15—30		47.4	59.5	82.7	139.7	169.9	176.5	182.7
	0—15	35	198.1	267.0	342.8	457.3	626.3	645.7	658.5
	15—30		83.0	115.7	144.4	196.8	282.1	296.3	304.2

由表2可知，时间与矿化氮累计量成正相关，经过数种(直线、对数、指数与幂)回归方程的分析结果，以幂回归的相关性最佳．幂回归方程为 $\hat{y} = Ax^B$，其中A是常数项；B是回归系数；x为培养周数；$\hat{y}$为一定时间内氮的矿化累计量．根据该式计算结果表明：r值多在0.97以上（$P < 0.01$），相关极显著(图1—图6)．

同一土层，温度与矿化氮累计量成明显的正相关．如34周的矿化氮累计值的直线回归是：高山草甸土0—10厘米土层的相关系数（r）为0.999；10—20厘米为0.967；20—

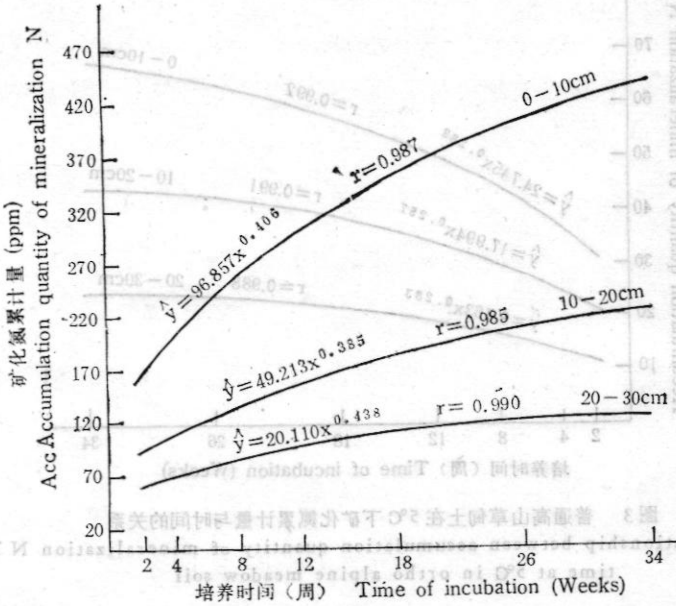

图 1　普通高山草甸土在 35℃ 下矿化氮累计量与时间的关系

Fig. 1　Relationship between accumulation quantity of mineralization N and time at 35℃ in ortho alpine meadow soil

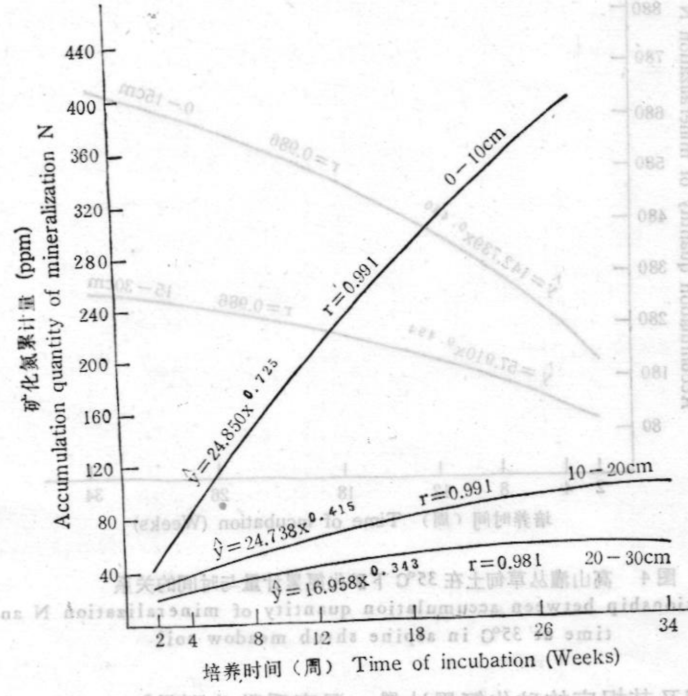

图 2　普通高山草甸土在 25℃ 下矿化氮累计量与时间的关系

Fig. 2　Relationship between accumulation quantity of mineralization N and time at 25℃ in ortho alpine meadow soil

30 厘米为 0.985。高山灌丛草甸土 0—15 厘米土层的相关系数为 0.990；15—30 厘米为 0.985。又以普通高山草甸土 0—10 厘米土层为例：温度与矿化氮累计值进行直线回归

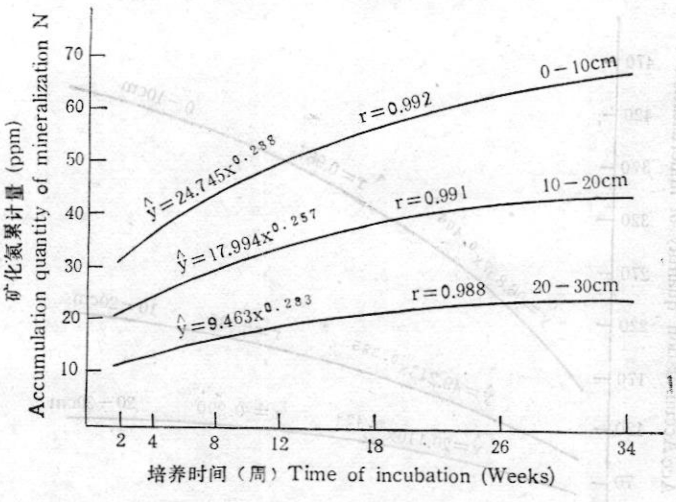

图3　普通高山草甸土在5℃下矿化氮累计量与时间的关系

Fig. 3　Relationship between accumulation quantity of mineralization N and time at 5℃ in ortho alpine meadow soil

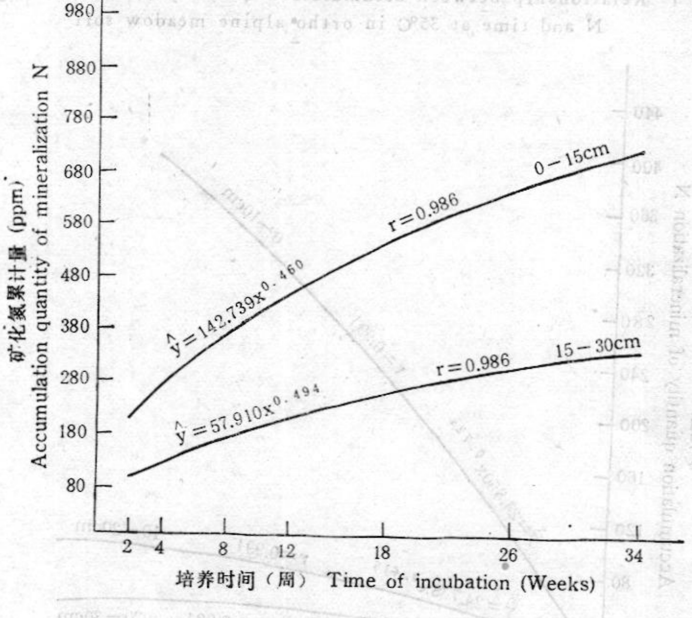

图4　高山灌丛草甸土在35℃下矿化氮累计量与时间的关系

Fig. 4　Relationship between accumulation quantity of mineralization N and time at 35℃ in alpine shrub meadow soil

分析，求出系列温度及其相应的矿化氮累计量．温度系数分别是：5—15℃为2.56（15℃的矿化氮累计量与5℃的比值）；10—20℃为1.88．15—25℃为1.61；20—30℃为1.47；25—35℃为1.38．温度系数随着温度的增加而逐渐减小．反映出高寒草甸土生态系统温度对有机态氮矿化的特殊作用．Reuss 等于1977年在美国 Pawnee 站（年平均气温8℃）的研究结果是：20—30℃的温度系数大约为2，与我们10—20℃的计算结果接近．从以

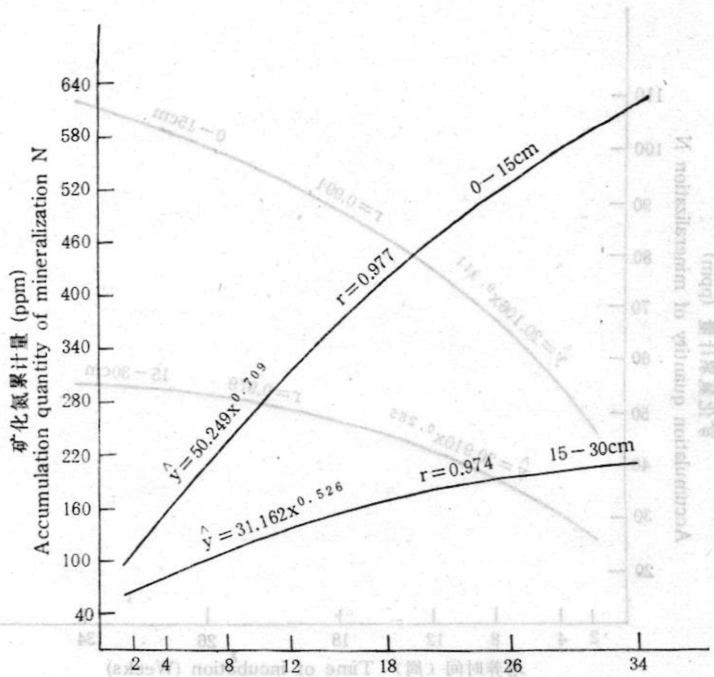

图 5　高山灌丛草甸土在 25℃ 下矿化氮累计量与时间的关系

Fig. 5　Relationship between accumulation quantity of mineralization N and time at 25℃ in alpine shrub meadow soil

上得出：　气候寒冷的地区热量对于有机态氮的矿化效应似乎较气候比较温暖地区敏感。

其次，相同培养温度，不同土壤全氮含量与其相应的矿化氮累计量亦成明显的正相关。仍以34周的矿化氮累计值为例，直线回归求得的相关系数是：普通高山草甸土 5℃ 的相关系数为 0.901；25℃ 为 0.977；35℃ 为 0.949。根据相关性评价，土壤全氮含量之差异对矿化氮累计量的影响稍逊于温度。由此可见，热量及其所产生的效应(如促进微生物活动等)是影响土壤有机氮矿化的主要因素。

(二) 矿化率

单位时间(以日计)的矿化量为日矿化率。土壤中有机氮的矿化速度与其中可矿化之氮量成正比，当可矿化氮量因矿化而递减时，矿化速度则相应减低。运用指数回归方程进行矿化率计算：　$\hat{y}=Ne^{kt}$。式中 $\hat{y}$ 为 t 日之累计矿化量 (ppm)；N 为培养 14 日的矿化量 (ppm)；t 为间隔时间(日)；k 为矿化率 (ppb. 日$^{-1}$)。据表 2 数据计算的矿化率列于表 3。

由表 3 可知，时间与矿化率成明显的反相关。 经分析，仍以幂回归的相关性最佳。幂回归方程为：　$\hat{y}=Ax^{B}$。式中 $\hat{y}$ 为各日之矿化率 (ppb. 日$^{-1}$)；x 为间隔时间（日）；A 为常数项；B 为回归系数。 结果表明，r 值多在 —0.95 以上，相关显著（图 7—图 12）。

由表 2 可见，培养温度为 35℃ 的两周的矿化氮量(始值)远超过 25℃ 的矿化氮量．以

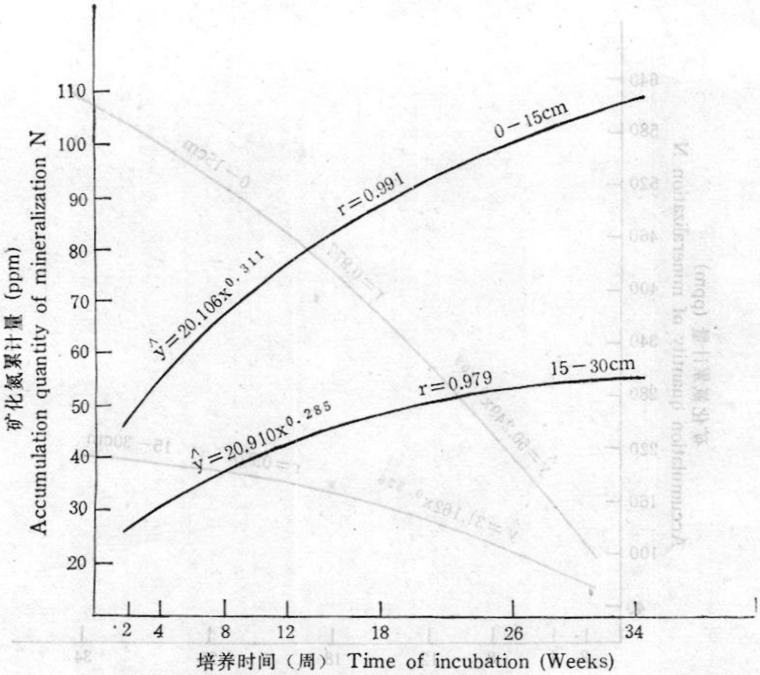

图 6　高山灌丛草甸土在 5℃ 下矿化氮累计量与时间的关系

Fig. 6　Relationship between accumulation quantity of mineralization N and time at 5℃ in alpine shrub meadow soil

表 3　高山草甸土在不同时间内氮素的矿化率（ppb. 日$^{-1}$）

Tabie 3　Nitrogen mineralization rate in alpine meadow soil at different time. (unit: ppb. day^{-1})

亚类 Subtype	深度(厘米) Depth (cm)	温度(℃) Temperature	14	42	70	112	168	224日 (days)
			矿化率 Mineralization rate					
普通高山草甸土 Ortho alpine meadow soil	0—10	5	13.57	8.89	6.78	6.26	4.41	3.45
	10—20		16.88	9.61	6.88	5.87	4.06	3.21
	20—30		21.91	10.33	7.89	6.56	4.55	3.62
	0—10	25	40.25	29.43	22.73	16.83	11.40	8.68
	10—20		15.93	11.42	10.58	8.76	6.22	4.90
	20—30		11.16	11.33	8.37	6.46	5.05	4.20
	0—10	35	25.73	14.55	11.59	9.43	6.44	4.93
	10—20		29.61	13.64	10.96	9.04	6.24	4.81
	20—30		19.31	14.04	11.65	9.59	6.63	5.14
高山灌丛草甸土 Alpine shrub meadow soil	0—15	5	13.11	8.91	7.90	6.66	4.70	3.66
	15—30		21.29	10.76	9.29	6.69	4.58	3.54
	0—15	25	27.46	21.34	23.22	16.54	11.22	8.48
	15—30		16.16	13.23	15.42	11.39	7.82	6.02
	0—15	35	21.34	13.06	11.96	10.28	7.03	3.36
	15—30		23.75	13.18	12.32	10.92	7.57	5.80

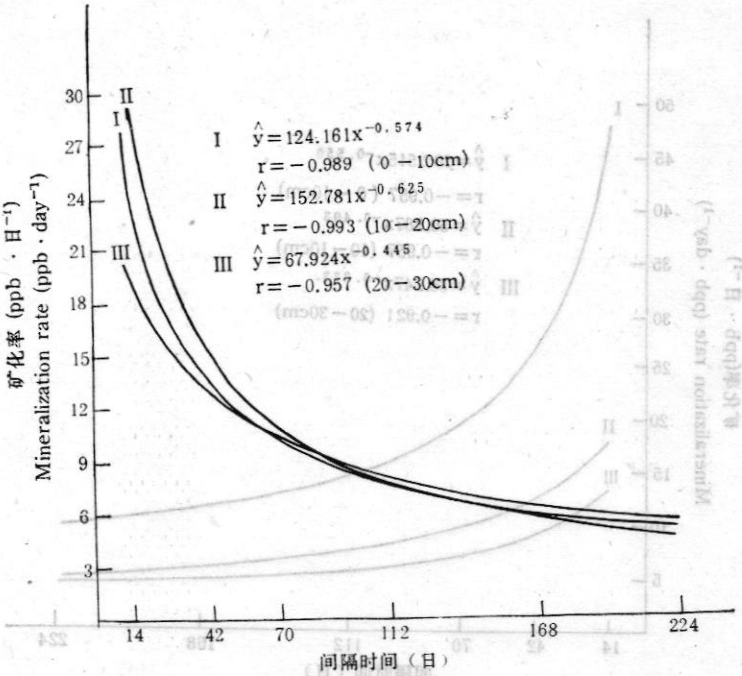

图7 普通高山草甸土在35℃下矿化率与时间的关系

Fig. 7 Relationship between mineralization rate and time at 35℃ in ortho alpine meadow soil

后两者不同间隔时间的累计量(终值)的差值相对缩小．矿化率之高低取决于终值与始值差值之大小,故两种土壤的矿化率均以25℃的为高．以34周的平均矿化率为例,根据二次回归方程的计算结果如下:

普通高山草甸土为:

$$\hat{y} = -0.0071x^2 + 0.338x + 1.9175$$

高山灌丛草甸土为:

$$\hat{y} = -0.0145x^2 + 0.618x + 0.8729$$

式中: $\hat{y}$ 为矿化率（ppb. 日$^{-1}$）

x 为培养温度(℃)

（三）矿化势

无限时间内矿化过程所获得的矿质氮量称为该土壤的矿化势（N_0）．矿化势是土壤肥力在容量方面的重要指标，可作为评价土壤肥力的重要依据．土壤有机态氮矿化有一个极限,并非全部可以矿化,因此,土壤氮的矿化势决不等于土壤全氮含量．

矿化势系根据34周培养于不同间隔时间进行淋洗测定的结果推导出来的． 根据Stanford 与 Smith 的推导结果,土壤矿化势的计算公式为:

$$1/N_t = 1/N_0 + b/t$$

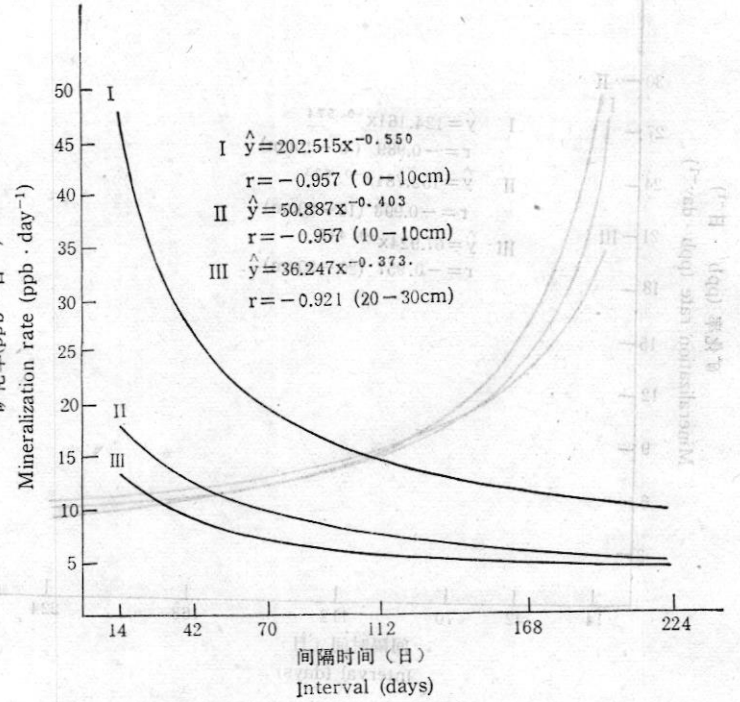

图 8 普通高山草甸土在25℃下矿化率与时间的关系

Fig. 8 Relationship between mineralization rate and time at 25℃ in ortho alpine meadow soil

式中: N_0 为矿化势（ppm）

N_t 为培养时间 t（34 周）内积累的矿质氮（ppm）

t 为时间(周)

b 为 $1/t$ 与 $1/N_t$ 的直线回归系数

由此得出两种土壤的氮素矿化势（表 4）

表 4 不同温度下氮素的矿化势

Table 4 Nitrogen mineralization potential in alpine meadow soil at different temperature. (unit: ppm)

亚类 Subtype	深度(厘米) Depth(cm)	5℃	25℃	35℃
		矿化势 N_0		
普通高山草甸土 Ortho alpine meadow soil	0—10	71.05	415.98	419.90
	10—20	45.50	116.36	201.55
	20—30	26.69	62.66	100.61
高山灌丛草甸土 Alpine shrub meadow soil	0—15	114.54	754.23	773.94
	15—30	57.24	225.11	365.77

矿化势与矿化氮累计量成明显的正相关。表 4 所列 N_0 与其相应的34周的累计值进行直线回归的结果为:

$$N_0 = 1.014 + 1.202N_t \qquad r = 0.991$$

N_0 与培养温度和土壤全氮含量成明显的正相关．因此，同一土层不同培养温度，或同一培养温度不同土层，N_0 占全氮的百分数皆异（表 5）．

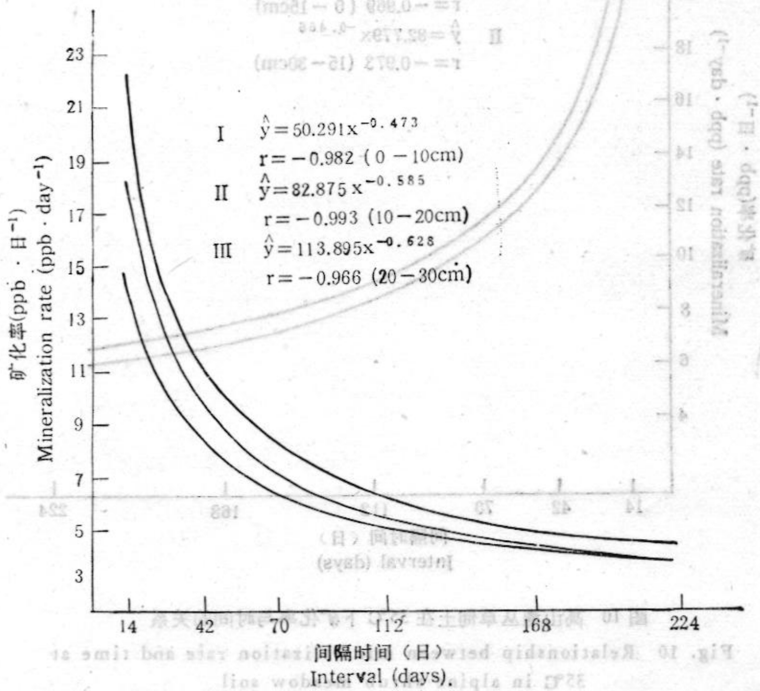

图9 普通高山草甸土在 5℃ 下矿化率与时间的关系

Fig. 9 Relationship between mineralization rate and time at 5℃ in ortho alpine meadow soil

表 5 高山草甸土在不同温度下氮素矿化势占全氮的百分数

Table 5 Percentage of nitrogen mineralization potential (N_0) in total nitrogen in alpine meadow soil at different temperature

亚类 Subtype	深度(厘米) Depth(cm)	5℃	25℃	35℃
		N_0 占全氮的百分率 % of N_0 in total nitrogen		
普通高山草甸土 Ortho alpine meadow soil	0—10	2.00	9.93	10.02
	10—20	1.16	2.97	5.14
	20—30	1.54	3.62	5.82
高山灌丛草甸土 Alpine shrub meadow soil	0—15	1.52	9.98	10.24
	15—30	2.20	4.71	7.65

Stanford 与 Smith 于 1972 年对美国多类土壤通过长期(32 周)培养 (35℃) 的结果是，N_0 占全氮的比数在 5—40% 之间．我们在相同温度条件下通过 34 周培养的结果，若以表土(0—10 厘米)而论，N_0 占全氮的 10% 左右，若以多层平均而言，N_0 约占 7%．N_0 占全氮的比数相当于上述学者研究结果的低值域．

Stanford 等人 1972，1973 年的研究，大量土壤样品的测定与计算结果 N_0 的值在 18—307ppm；我们的研究结果是，普通高山草甸土 3 层平均 25℃ N_0 值 198.3ppm，35℃

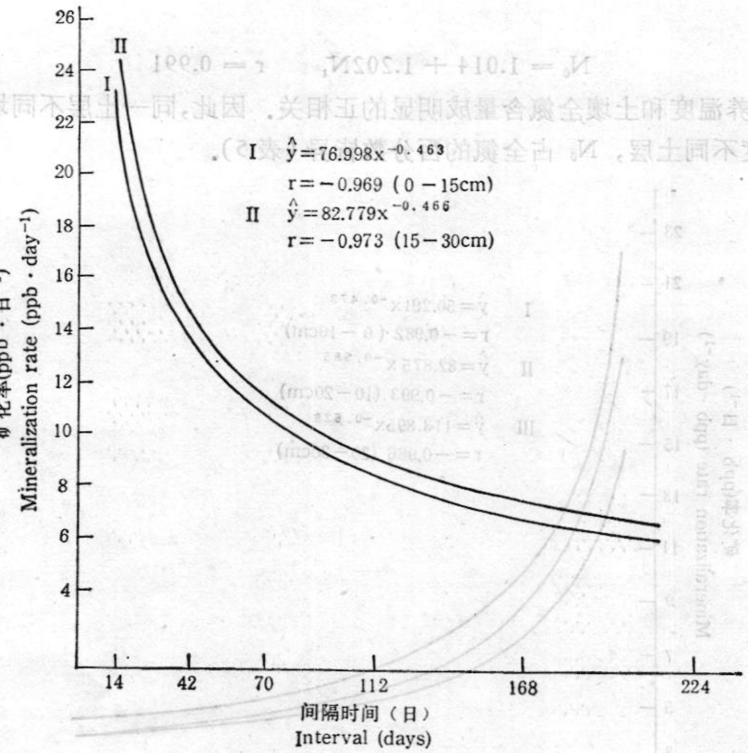

图 10　高山灌丛草甸土在 35℃ 下矿化率与时间的关系

Fig. 10　Relationship between mineralization rate and time at 35℃ in alpine shrub meadow soil

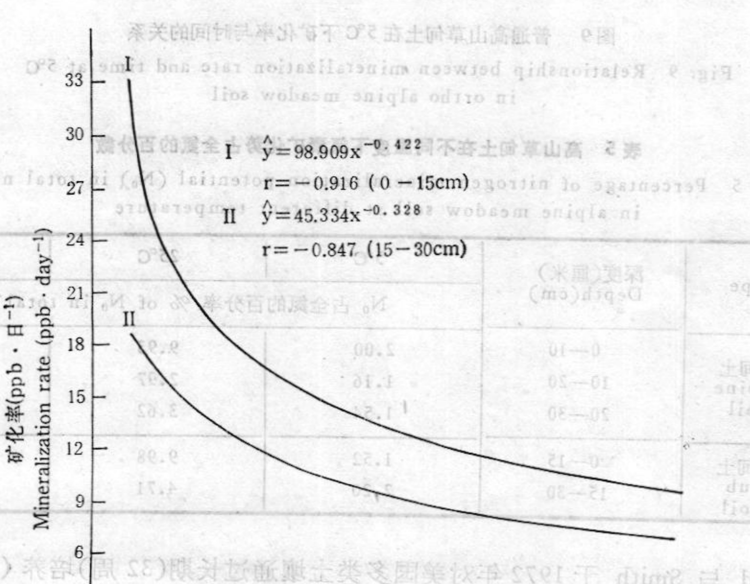

图 11　高山灌丛草甸土在 25℃ 下矿化率与时间的关系

Fig. 11　Relationship between mineralization rate and time at 25℃ in alpine shrub meadow soil

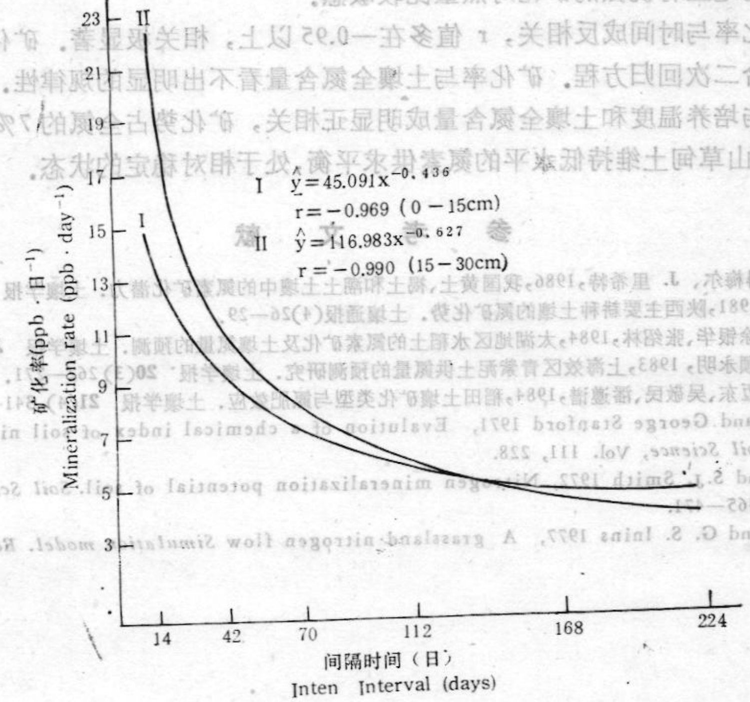

图 12 高山灌丛草甸土在 5℃ 下矿化率与时间的关系

Fig. 12 Relationship between mineralization rate and time at 5℃ in ahpine shrub meadow soil

N_0 值 240.2ppm; 而高山灌丛草甸土 3 层平均 25℃ N_0 值489.7ppm, 35℃ N_0 值 569.8 ppm; 虽然 N_0 值在 Stanford 的范围或高于 Stanford 的 N_0 值，但由于土样采自气候寒冷，年均气温约—2℃。最热月(7 月)日平均气温不到 10℃，牧草生长期(6—9 月)平均气温多在 5—9℃ 之间。根据有机氮矿化与立地条件(气温、土壤水分及其配合优劣等)分析，矿化速率缓慢，矿化强度弱，每年可矿化的氮素量很低是必然结果，从而体现了高山草甸土物质库中氮素的供应特点：维持低水平的供求平衡，动用库容量较小。从物质循环的观点评价，土壤处于相对稳定状态。若不改变热量条件，土壤供氮能力是有限的，难以满足牧草高产之需要。

三、小 结

氮素的矿化累计量与时间、培养温度和土壤全氮含量成明显的正相关，其中以培养温度的相关性最显著。土壤全氮含量相同，不同培养温度氮素的矿化累计量相差悬殊：培养 34 周后，全氮含量为 0.419% 的高山草甸土表层(0—10 厘米)，5℃ 的氮素矿化累计量为 65.9ppm，25℃ 与 35℃ 则分别为 256.2 与 366.9ppm。全氮含量为 0.756% 的高山灌丛草甸土 5℃、25℃ 与 35℃ 则依次为 105.0、548.5 与 658.5ppm。培养温度相同，土壤全氮含量不同，氮素的矿化累积量亦有明显的差异。

高山草甸土温度系数随温度的增加而逐渐降低，经与美国 Pownee 站对比，得出：气

候比较寒冷的地区有机氮的矿化对热量比较敏感。

氮素矿化率与时间成反相关，r 值多在−0.95以上，相关极显著。矿化率与培养温度的关系符合二次回归方程。矿化率与土壤全氮含量看不出明显的规律性。

矿化势与培养温度和土壤全氮含量成明显正相关，矿化势占全氮的7%左右。在自然条件下，高山草甸土维持低水平的氮素供求平衡，处于相对稳定的状态。

参 考 文 献

王湧清、H. 洛得梅尔、J. 里希特，1986，我国黄土、褐土和潮土土壤中的氮素矿化潜力. 土壤学报 **23**(1) 1—9.

白志坚、赵更生，1981，陕西主要耕种土壤的氮矿化势. 土壤通报(4)26—29.

朱兆良、蔡贵信、徐银华、张绍林，1984，太湖地区水稻土的氮素矿化及土壤氮量的预测. 土壤学报 **21**(1) 29—35.

汪寅虎、姜素真、顾永明，1983，上海效区青紫泥土供氮量的预测研究. 土壤学报 **20**(3) 262—271.

高家骅、章云、黄迈东、吴敬民、潘遵谱，1984，稻田土壤矿化类型与氮肥效应. 土壤学报 **21**(4) 341—349.

Smith, S. J., and George Stanford 1971, Evalution of a chemical index of soil nitrogen availability. *Soil Science*, Vol. 111, 228.

Stanford, G., and S. J. Smith 1972, Nitrogen mineralization potential of soil. *Soil Sci. Amer. Proc.*, Vol. 36, 465—471.

Reuss, J. O., and G. S. Inins 1977, A grassland nitrogen flow *Simulation model. Ecology*, **58**(2): 379—338.

MINERALIZATION OF SOIL ORGANIC NITROGEN IN ALPINE MEADOW SOILS

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In a native alpine meadow, the N taken up by the plants is mainly derived from the soil where most of it is located in the soil organic matter. Therefore, the mineralization of the soil organic N is an important indicator of the nutrient which may be taken as an indicator of the productivity of the soil. The mineralization of soil organic N also provided data for the study of nitrogen cycling.

Samples of alpine meadow and alpine shrub soil were obtained from the Haibei Research Station in May 1984. The alpine meadow soil supports communities dominated by *Kobresia humilis*. The total N content of this soil is 0.419%, 0.392% and 0.173% in the respective depths of 0—10 cm, 10—20 cm and 20—30 cm. The alpine shrub meadow soil supports communities dominated by *Dasiphora fruticosa*. This soil contained 0.756% and 0.478% of total N in the 0—15 cm and 15—30 cm soil layers, respectively. The mineralization of organic N in the soil was determined over 34 week period at 35°C, 25°C and 5°C. The incubation intervals were 2, 2, 4, 4, 6, 8 and 8 weeks. Mineral N was leached initially and after each incubation with 25 ml of 0.01 M $CaCl_2$ followed by 25 ml of a minus-N nurtrient solution. The water content of the soil used in the experiment was adjusted at 60% of the field capacity. The mineralization N determined by the Kje-ldahl's method.

1. Accumulation of mineralization N

The equation for the accumulation of mineralization N in the soil is $Y=AX^B$, where Y denotes the amount of accumulated N (ppm), X denotes accumulation time (day), and A and B are constants.

The constant of the equations show that the mineralization of the soil organic N is closely related to the temperature of the incubation and to the soil depth. The amount of accumulated mineralization N increased with an increase in the total N in the soil. The correlation coefficients between accumulated N and the incubation temperature were higher than the correlation coefficients between the amount of accumulated N and the amount of total N. The amount of accumulated N also varied with the time of the incubation.

2. Mineralization rate

The rate of mineralization was calculated by $Y=AX^B$. The parameters of the equations show that the mineralization rate was markedly correlated both to the temperture of the incubation and to the soil depth. The mineralization rate also varied with the amount of the total N. The correlation coefficients between the mineralization rate and the incubation temperature were higher than those between the mineralization rate and the content of total N. The mineralization rate was decreased with increasing time.

3. Mineralization potential

The mineralization potential varied significantly with the incubation temperature and with the content of the total N in the soil. The mineralization potentials are shown in Table 1.

Table 1 Mineralization potentials (ppm) at different soil depths and incubation temperatures

Subtype	Depth (cm)	Temperature of incubation		
		5℃	25℃	35℃
Ortho alpine meadow soil	0—10	71.05	415.98	419.90
	10—20	45.52	116.36	201.55
	20—30	26.69	62.66	100.61
Alpine shrub meadow soil	0—15	114.54	754.23	773.94
	15—30	57.24	223.11	365.77

The mean mineralization potentials for the 0—30 cm soil horizon in the alpine meadow soil were 47.75 ppm (5°C), 231.33 ppm (25°C) and 240.69 ppm (35°C). These values correspond to 1.57% 5.51% and 6.69% of mean total N content in the 0—30 cm soil horizon, respectively. In the alpine shrub meadow soil, the potentials were 85.89 ppm, 489.67 ppm and 569.89 ppm, which correspond to 1.86%, 7.35% and 8.95% of total N, respectively. Under the field conditions, Because the process of N mineralization is weak, lower values of available N can't satisfy the needs of the plants.

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