GEOLOGY OF THE UDON THANI POTASH (SYLVINITE) DEPOSITS
WITH AN OVERVIEW FOR DEVELOPMENT OF A SUSTAINABLE
POTASSIUM RESOURCE FOR THAILAND

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ABSTRACT
An exploration program conducted by Asia Pacific Resources Ltd. during the 1990s delineated two adjacent deposits, Udon South and Udon North containing sylvinite-type potash in the province of Udon Thani, Thailand. An extensive exploration program that included drilling, 2D and 3D-seismic provided a database of sufficient quality and distribution to develop Canadian National Instrument 43-101 and Australian JORC compliant resource and reserve estimates. The Udon deposits are unique within the Khorat Plateau as they present a mineable seam of sylvite (KCl) mineralization that is comparable in grade and purity of any global potash deposit.

A recent geology model and resource estimation conducted for the Udon South potash deposit confirmed total sylvinite resources of 294 million tones with weighted average grade of 22.9% K₂O and average thickness of 2.3 meters. This is sufficient reserves to produce 2 Mtpa of KCl product during a mine-life of 22-years. In addition, a geological model and resource study conducted for the Udon North potash deposit estimated a resource of 665 million tones sylvinite with average weighted grade 17.1% K₂O with average thickness of 12.0 meters. These resources are sufficient to provide Thailand with much needed potassium (K) fertilizer for generations.

This paper provides an overview of the exploration and geology of the Udon Thani potash (sylvinite) resource. Also included is a discussion on the potential to develop a long-term, sustainable resource of potassium (K) that will bring self-sufficiency to Thailand in the potassium ingredient of fertilizer while satisfying the King’s concept of providing a “sufficient economy” within the agricultural community of the country.

Keywords: Potash, Udon Thani, sylvinite, sustainable resource, sufficient economy;

INTRODUCTION
Asia Pacific Potash Corporation, Ltd. was awarded a potash concession located in the northeastern province of Udon Thani, Thailand in 1984. The original concession totaled 2,330 square kilometers, with the objective of exploring, developing and marketing a commercial deposit of sylvinite-type potash rock. Since exploration was initiated in 1993, two sylvinite potash deposits, described as Udon South and Udon North were delineated approximately 15 and 10-kilometers respectfully southeast of the capital city of Udon Thani (Fig. 1).

During a five-year period APPC completed 169 exploration and reconnaissance boreholes, and over 550 line-kilometers of 2D-seismic surveys to delineate the Udon South and Udon North sylvinite deposits. By 1998, the resource boundary of the Udon South sylvinite deposit was delineated with 63-boreholes, 250 line-kilometers of 2D-seismic and 2 square kilometers of 3D-seismic surveys. During the period 1996 to 1998, field and laboratory programs were implemented to collect an array of hydrogeological data from local formation aquifers and geotechnical data from surface soil and shallow to deep formation rock for geotechnical testing and geomechanical modeling. In support of the exploration programs, extensive geochemical assay programs provided key analytical data used for resource modeling estimation.

By 2000, the Udon North sylvinite deposit was explored with 92 boreholes and 300 line-kilometers of 2D-seismic. In addition, several boreholes were drilled and seismic lines surveyed for reconnaissance purposes within the original concession area.

This extensive collection of geological information has provided for resource delineation and geological modeling that is necessary to understand one of the world’s most unique potash (sylvinite) deposits. Feasibility studies have confirmed the mine ability and economic viability of the Udon South potash (KCl) resource. The next phase is approval for mine development that will take Thailand closer to recognizing the country’s potential of becoming self-sufficient in its fertilizer N-P-K requirements.

REGIONAL GEOLOGY
The late-Cretaceous age Udon sylvinite deposits are located in the province of Udon Thani, Thailand. Northeast Thailand covers approximately 150,000 square kilometers that contains a broad circular-shaped synclinorium called the Khorat Plateau. The so-called plateau forms a block-like platform that extends across the
boundary of Thailand into central and southern Laos, western Cambodia and western Vietnam. The Khorat Plateau is positioned within the Indochina Block of Southeast Asia that contains thick sedimentary rock ranging in age from late Cambrian to Recent (Sattayarak et al, 1989). The Phu Phan Uplift or anticlinorium separates the Khorat Plateau into the southern Khorat and the northern Sakon Nakhon evaporite basins. The two basins cover an area nearly 60,000 square kilometers as identified within the Thailand border. Bunopas and Vella (1992) suggest that the Khorat and Sakon Nakhon Basins resulted from late tectonic relaxation or extension during late Triassic age that followed the Triassic collision between Shan-Thai and the Indochina microplates. Triassic age tectonics created half and full graben basins that filled with sediments. Middle Triassic to early Cretaceous age fluvial and lacustrine siliciclastic facies of the Khorat Group filled the Khorat graben basin with polymictic conglomerates, sandstones, siltstone, shale, mudstone and micritic limestone. Within the Khorat Plateau, an unnamed group containing late-Cretaceous age sediments of the Maha Sarakham Formation unconformably overlies the Khorat Group. The evaporate-bearing Maha Sarakham Formation occurs only within the Khorat and Sakon Nakhon Evaporite Basins. An accumulated thickness of over 1000 meters of evaporite and clastic sediments were deposited within the basin center. During the Early Tertiary Himalayan Orogeny, sub-crops of Permian and Triassic strata were in part inverted that caused uplifting of the Khorat Plateau. Topographically the Khorat Plateau sits approximately 100 to 200 meters above mean sea level. A typical stratigraphic section of the Maha Sarakham Formation in the Udon Thani area is about 500 meters in thickness.

GEOLOGICAL SETTING OF THE UDON SYLVINITE DEPOSITS

General Stratigraphy of the Udon Potash Deposits

Two potash deposits with sylvinite (KCl) mineralogy are preserved upon a shelf-like structure referred to here as the Udon Morphological High located within the southwestern corner of the Sakon Nakhon Basin (Crosby 2005). Over the Udon Morphological High, the Maha Sarakham Formation retains a consistent range in stratigraphic thickness of 400 to 500 meters. The formation thickness however exceeds 800m down slope towards the center of the Sakon Nakhon Basin. The Maha Sarakham Formation unconformably overlies the early Cretaceous-age Khok Krut Formation of the Khorat Group. There is a sharp change in depositional environments that marks the end of the consistent continental clastic sediments of the Khok Krut with a marine evaporite depositional environment that dominants
the Maha Sarakham Formation. The Maha Sarakham however, also retains a thick succession of sili-clastic red beds comprising of claystone and mudstone referred to as the Lower, Middle and Upper Clastics members. These members in turn are intercalated with thick evaporite strata referred to as the Lower, Middle and Upper Salt members (Hite and Japakasetr, 1979). Potash mineralization occurs only within the upper third of the Lower Salt member.

One or more members of the Maha Sarakham Formation and/or lithostratigraphic units from the Lower Salt member may be missing as a result of non-deposition, post-depositional erosion, late burial stage dissolution, congruent alteration by meteoric waters and localized salt halokinetics. Figure 2 provides range and average thickness of lithostratigraphic units within the Maha Sarakham Formation at Udon South.

The Udon South and North potash deposits are characterized by a Lower Salt member that is comprised of 10 lithostratigraphic units. There are no lithostratigraphic facies changes between the Udon South and Udon North sylvinite deposits, because in essence, they are the same deposit. Mineralogies and lithologies are consistent and correlatable across each deposit. However, most units do show short lateral discontinuity as result of epigenetic and diagenetic events. The lithostratigraphic units of the Udon South and North potash deposits are described in detail in (Crosby, 2005). Following is a brief description of the primary lithostratigraphic units of the Lower Salt member that represent a future mining horizon at Udon South.

![Stratigraphic Column](image)

Figure 2. Typical stratigraphy of Udon South sylvinite deposit showing range and average thickness of lithostratigraphic units.

**Lithostratigraphic Units of the Mining Horizon**

**Residual Bed unit (RBU):** The Lower Salt member of the Maha Sarakham Formation is overlain by greenish grey claystone and reddish brown mudstones of the Lower Clastics member. The stratigraphic succession represents a period of regression from marine to a continental depositional environment. On a local basis the upper contact of the Lower Salt member is characterized by the Residual Bed unit (RBU) or cap rock that represents a period of either very early dissolution of salt strata as a result of ponding of fresher water and/or late stage burial
dissolution. The thickness of the residual bed across the Udon deposits is highly variable with absence of unit to 1 meter in thickness, and average thickness of about 10 centimeters.

The residuum composition of the RBU represents the chemistry of the insoluble fraction of the leached halite and sylvinitic strata. The residuum includes remnants of illite and chlorite clays, gypsum or anhydrite, boron, quartz, mica andfeldspar. The bed is typically light to dark grey or greenish grey, friable and non-competent. The most distinct property of the RBU is the thinly laminated or varved-like nature of the interval that probably resulted from sporadic episodes of dissolution and variable composition of the dissolved strata. Only twenty per cent of the boreholes cored within the Udon South contained the RBU.

The thickness of the RBU is probably proportional to the thickness and volume of salts dissolved during early post-depositional erosion and/or subsequent period of late stage burial dissolution from descending fresher waters from overlying clastic sediments. This resulted with removal of variable thickness of the Upper Halite Cover unit and more rarely the Somboon Sylvinite Ore Type unit. Similar residual beds occur in many other global marine evaporite deposits (Crosby, 1991 and Hoffman and Crosby, 1987).

**Upper Halite Cover unit (UHC):** The Upper Halite Cover unit or “roof beam” is comprised of argillaceous to clean, barren halite. Locally halite is inter-banded or bedded with low-grade sylvinite. The UHC is characterized by its multi-colored beds of brown, orange-brown, milky white, colorless (translucent) to grey hues. Grain size is also variable from very fine to medium-grained (<0.5 – 10mm). The halite is relatively clean, averaging 3 to 4% insoluble material.

Only two of the 63 resource delineation boreholes did not intersect the UHC unit and these were located over structural highs. Thickness of the UHC is proportional to the degree of post-depositional erosion, and early or late stage dissolution of the interval. Consequently, the apparent thickness of the UHC has a variable range of 0.2m to 16.5m and average 3.8 meters. Bedding characteristics vary from thin laminated (<6mm) to medium bedded (200-600mm) multi-colored halite, sylvinitic and clay beds.

The bedding gradient is primarily flat lying from zero to 10 degrees. However gradients of 50 to 60 degrees can be observed where boreholes are located along flanks of moderate anticlines or rim synclines.

**Somboon Sylvinite Ore Type unit (SOT):** The Somboon Sylvinite Ore Type is characterized by distinct brick red, orange to dark brown sylvinite within a colorless to milky white halite matrix. Typically the SOT sylvinite is very fine-grained (<0.5mm) to fine-grained (<5mm), with average grain size of both sylvinite and halite mineral fractions approximately <1.0 millimeter.

The SOT contains an average concentration of miscellaneous insoluble and soluble minerals of about 1.5 per cent. The unit demonstrates variable thickness of 0.3 to 7.1m as result of localized removal of upper strata, with an average thickness of 2.1 meters.

In general, the unit is thinly laminated to medium banded with barren halite, providing evidence of cyclical, primary precipitation. The bedding exhibited within the SOT is normally undisturbed and halokinetic flow angles are rarely observed except along flanks of moderate anticlines and rim synclines.

**Intervening Middle Halite unit (IMH):** The Intervening Middle Halite unit was intersected in only seven exploration boreholes within the Udon South and Udon North deposits. The IMH is characterized by barren, fine to medium-grained, colorless halite locally interbanded with low-grade, colorless to orange sylvinitic. Four intersections within the Udon South contained a thickness range of 0.1 to 4.9 meters.

**Udon Sylvinite Ore Type unit (UOT):** The lowermost sylvinitic unit described as the Udon Sylvinite Ore Type unit is distinctly secondary and typical of other localized sylvinitic pods observed within the Khorat Plateau. The sylvinitic and halite mineral fractions are both characterized by colorless (translucent to transparent), light grey, to milky white coloration. There is an absence of dark coloration normally typified by the presence of iron oxide, carbonaceous or clay impurities. Grain size is highly heterogeneous, ranging from fine to coarse-grain (<0.5 to 10mm), rarely 40mm, and average about 2 to 3 millimeters.

The UOT is especially characterized by the low concentration of less than 1% of miscellaneous insoluble and soluble material represented by minute inclusions of illite clay or borate mineralization (boracite, hilgardite), with trace amounts of quartz, Mg-Fe chlorite and dolomite. On a rare and local basis, the UOT is interbanded with near barren halite several centimeters in thickness. Locally there are gradual increases in magnesium near the bottom contact with underlying carnallitite.

The apparent thickness range is 0.3 to 11.8m, with average thickness of 2.6meters. The bedding gradient is variable across the deposit but averages less than 15 degrees.

**Intervening Floor Halite unit (IFH):** The Intervening Floor Halite unit is present over only 20 per cent of the Udon South deposit. This barren halite interval is localized over a structural rim synclinal depression along the north sector of the deposit as result of congruent alteration of carnallitite. Where present, the unit will act as floor beam material of a mine. The IFH is characterized by colorless, light grey, fine to medium-grained, barren halite with localized inter-bands of sylvinitic. The IFH is primarily barren of carnallite, although disseminated secondary sylvinitic mineralization can occur as grains or patches of less than 5 to 10 per cent of rock volume.

Similar to the CHU, the bedding gradient of the IFH is normally flat-lying from zero to <15 degrees. The unit
retains a variable thickness range of 0.4m to 9.1m with an average thickness of 3.7 meters.

**Carnallite Horizon unit (CHU):** The Carnallite Horizon unit is characterized by an admixture of variable colorless, milky white, pink, orange to purple hues of the mineral carnallite and a colorless to milky white halite matrix. Carnallite mineralization is primarily microcrystalline to very fine-grained occurring as irregular patches along halite grain crevices. The halite matrix is much coarser than the carnallite fraction as medium to very coarse-grained, a property that results in a distinct granular and friable texture and easy dissolution. The CHU is also characterized by the highly variable concentration of carnallite mineralization both laterally and vertically. Assay and visual observation indicate the upper 10m of the unit may contains less than 10% or greater than 80% carnallite mineralization with a corresponding percentage of halite. Other soluble and insoluble minerals such as sylvite, borates, anhydrite or clay rarely exceed 1 to 2%. In the upper 5m of the CHU the average carnallite mineral content is 50 to 55 per cent. The thickest interval of the CHU, 67.5 meters, was cored within the Udon South deposit however there were also boreholes with no carnallitite intersection. Total thickness of the CHU was rarely cored although 2D-seismic provides a good indication of thickness. Where present, the CHU has a highly variable thickness range of 6.4 to 67.5m with an average of 22.6 m.

**MINERALOGY OF THE UDON POTASH DEPOSITS**

The Udon South and Udon North potash deposits contain two potassium evaporite minerals, sylvite and carnallite. The mineral sylvite (KCl) occurs as an admixture with the mineral halite (NaCl) as a matrix to form the rock sylvinite. Variable although low concentrations of illite-type clay, vermicularite, Mg-Fe chlorite, hematite, anhydrite, quartz, dolomite and borate minerals including boracite, hilgardite and szabibelyite make up the primary miscellaneous insoluble and soluble material within the sylvinite beds. The mineral carnallite (K\(\text{MgCl}_3\cdot 6\text{H}_2\text{O}\)) occurs as an admixture with the mineral halite (NaCl) as a matrix to form the rock carnallitite. Minor concentrations of sylvite, borate minerals and anhydrite occur within the carnallitite beds.

**Udon Morphological High and Related Structures**

Potash in the form of sylvinite and carnallitite are preserved within the Udon South and Udon North deposits over a flat to undulating platform like basement feature referred to as the Udon Morphological High (Crosby, 2005). As determined by 2D-seismic and drill holes, the complex dominants the southwestern corner of the Sakon Nakhon basin near the city of Udon Thani and covers an area of approximately 250 km² (Fig. 3). The gravimetric basement contains fine-grained clastic
sediments of the early Cretaceous age Khorat Group at stratigraphic elevations of 100 to 200 meters over the majority of the Sakon Nakhon basin. The western and southern boundary of the Udon Morphological High is determined by the Sakon Nakhon Basin boundary that is defined by the tectonically induced highlands of the Phu Phan Range. Within five kilometers of the Phu Phan Range, seismic indicates flat-lying basement strata of the Khok Kruat Formation overlain by positive, on-lapping bedding of Maha Sarakham Formation strata where gradients of nearly 25 degrees occur and elevations to top surface of the Lower Salt member rise to within 50 meters of surface.

Over the Udon Morphological High, the Khok Kruat basement is flat to gently undulating, with no seismic or drilling evidence of stratigraphic displacement. Depth to the Khok Kruat basement is typically 550 to 600 meters. Sediments representing all lithostratigraphic intervals of the Maha Sarakham Formation are present within the Udon deposits. This is an important characteristic feature over the Udon Morphological High, as it may reflect in part circumstances that helped preserve the sylvinite resource.

The exploration program also delineated numerous salt structures that are common throughout the Khorat Plateau. These include broad, gentle anticlines that characterize the western sector of the Udon South sylvinite deposit and narrow, moderately dipping anticlines that characterize the Udon North deposit. Several anticlines rise to within 100 meters of surface with crests one kilometer in width. The Udon North potash deposit is best described as a series of oval-like rim synclines or depressions bordered by low to moderate anticlines with variable width. One primary syncline is 4-km across with the deepest elevation point to the top of Lower Salt at 230 meters.

The southern and eastern perimeter of the Udon Morphological High is characterized by steep gradient relief commencing at the stratigraphic level of the Middle Clastics member down to the Khok Kruat Formation or recognized basement seismic reflector. Seismic surveys confirm additional structural relief towards the basin center of over 150 meters to the top of the Khok Kruat basement where depth exceeds 750 meters. Simultaneously, structural elevations to top of the Lower Salt member increase from typical depths of 150 to 350 meters over the Udon South and North deposits to over 450 meters in an easterly direction. This indicates a deepening at the Lower Salt member horizon of about 200 meters towards basin center.

The structural depressions present towards the basin center are probably the result of several diagenetic events including sediment compaction at the Khorat Group level, outward flowage of salt as result of increased compaction and loading from overlying sediments and weak tectonic movement along the Phu Phan Uplift. It is apparent that as salt flowed outward in a radial-like pattern, synclinal depressions were formed and rimmed by structural highs in the form of salt anticlines and domes. Contemporaneous movement during deposition of the total Maha Sarakham succession, especially a late stage episode of salt dissolution during or after deposition of the Upper Clastics probably resulted in the differential loading necessary to initiate salt flowage. These events formed the rim synclines, anticlines and domes throughout the Khorat Plateau. The various stages or degree of diagenesis however, appear to have been less extensive over the Udon Morphological High. Depending on degree and type of diagenetic event, potash in the form of carnallitite and more rarely secondary and primary sylvinite remain. Within the Udon South and potentially within the North deposit, continuous, lenses of mineable sylvinite-type potash are preserved as a potential potassium resource for the Kingdom of Thailand and its neighbors.

SYLVINITE RESOURCES AND RESERVES

Resources

Udon South resource estimates were recently conducted in compliance with Canadian NI 43-101 and Australian Code (JORC 2004) requirements. Using 2D-seam models, total estimated sylvinite resources within a new geology model having a “zero edge” perimeter is 294 million tones. Average thickness is 2.3m with a weighted average grade of 22.9% K₂O. Measured and indicated resources total 239 Mt with average thickness of 3.1m and grade of 23.4% K₂O (Mining Associates Pty Ltd., 2007). The 2007 resource estimate and historic reserve estimates indicate sufficient resource and reserves for an approximate 22-year mine life with production targets of 3.0 Mtpa ROM mine output, ramping up to 6.0 Mtpa ROM mine output by year six.

In 2002, APPC also contracted a geological and resource estimation modeling study for the Udon North deposit in compliance with Canadian NI 43-10. The resource study estimated a total of 665 million tone of inferred and indicated resources with an average thickness of 12.0 m and a weighted average grade of 17.1% K₂O. Total reserves respectfully. Inferred resources are not included and indicated resources become proven and probable reserves. Inferred resources with an average thickne ss of 12.0 m and a weighted average grade of 17.1% K₂O. Total reserves are approximately 25 square kilometers. Measured and indicated resources become proven and probable reserves respectfully. Inferred resources are not included as reserves and therefore are exempt from mine planning. The latest feasibility mine plan conducted in 2003 provided for a mineable reserve of 118 Mt of sylvinite ore with an average ROM grade of 23.4% K₂O. Total reserves include 49 Mt of proven reserves at 24.4% K₂O and 69 Mt of probable reserves at 23.9% K₂O.
The mining plan achieves an overall projected recovery of 54.9% of the total in-place mineable sylvinite ore. The remaining reserves were left as pillar, roof and floor beam support to retain mine stability and keep mine convergence and surface subsidence to a minimum. As a result of higher structural complexity in the southwestern region of the deposit, resources are designated as inferred and are not incorporated in the mine plan. There remains potential for inferred resources to be upgraded to “indicated” resource and subsequently to reserve status with additional 3D-seismic and/or underground delineation drilling.

A mining feasibility study with reserve estimation has not been conducted for the Udon North deposit.

POTENTIAL FOR A SUFFICIENT ECONOMY IN POTASSIUM

His Majesty King Bhumibol of Thailand has introduced the concept of “sufficient economy” to the Thai people. The concept has been widely applied and is successful in many areas. However, it is still possible for Thailand to benefit more from its own natural mineral resources in a sustainable manner.

An excellent example of a mineral resource that could be developed to sustain and indeed improve upon a sufficient economy for Thailand is potash. It cannot be said that Thailand has an overuse of this natural mineral resource. In fact there is no development of this natural resource sector in Thailand. Currently Thailand does not have a potash mining or processing industry. Thailand is primarily dependent upon the import of potassium to meet its fertilizer requirements and imports approximately 400,000 tone/annum of potassium fertilizer for its agricultural needs. This is unnecessary, because Thailand does possess one of the few economic global potash deposits that could be used to develop a sustainable potassium source for its agricultural industry for generations as well as improve the social-economic conditions of the Thai people.

APPC has explored and delineated large resources and reserves of potash in the form of high-grade “sylvinite” rock in the Northeastern province of Udon Thani. Once a mine is developed, the dependence on foreign potash products could be quickly reversed. Within two years of development, the Udon South mine could supply 100% of Thailand’s potassium requirements in the form of the potassium (K) fraction of a typical N-P-K fertilizer, making Thailand self-sufficient in its potassium requirements.

The province of Udon Thani has one of the most poor economies and high unemployment records of Thailand. Despite progress being made in poverty reduction, regional disparities remain large in the Northeast. Substantial reduction in overall poverty has been witnessed in Thailand, including the Northeast however the Northeast is still home to 50% of the poor in Thailand. The average individual income in the Northeast is only one-third that of Bangkok. The Northeast contribution to Thailand’s GDP fell from 16% to only 9% between 1970 and 2004, even though the population share remained constant at one-third. The slow pace of change has held back poverty reduction. Northeast rice farmers account for over half of the Thailand poor and one in two Northeast families rely on migration and remittances to increase incomes. Of the more blatant disparities is the expenditure gap between the Northeast and other regions in channeling public resources. In 2003 the Northeast obtained one-third less than the Center region of Thailand and 27% less than the North and South regions (NESDB and World Bank, 2005).

Several of the positive socio-economic impacts of a potash mine include: distribution of royalties and corporate taxes to national, provincial, affected sub-district and other sub-district governments; employment, procurement and income; job training; and business development. The additional injected money from such a project will not only be used for economic developments in different levels of society but will also introduce a continuing stream of money circulation in other sectors such as the retail business, etc. This multiplier effect will induce further economic growth for the benefit of the people of Udon Thani province. Mine employment and procurement will generate not only positive direct benefits on the local economy but also significant indirect and induced benefits. For example, much of the expenditure for the mine will flow through Udon Thani suppliers and create some indirect employment, although given the poor industrial base of the region goods are more likely to be brought in from other regions of the country. In addition, the operation phase of the mine will procure materials, power, fuel and equipment. Although much of the procured goods will necessarily come from outside Udon Thani province, the funds will flow through local suppliers creating positive indirect employment and income. Perhaps one of the more positive social benefits will be the return of skilled residents from employment outside the area, including labor migrants, new direct hires and economic migrants.

Singularly, the Udon South potash project has the potential to provide the Kingdom of Thailand with a sustainable potassium resource that can reverse its dependence on imported potassium fertilizer products and create a sufficiency economy in potassium. This will contribute to improved equality and quality of lives especially for residents in Northeastern Thailand.

SUMMARY

Thailand, and in particular the Province of Udon Thani is fortunate to possess a unique geological regime that includes large resources of high-grade, sylvinite-type potash. Asia Pacific Potash Corporation, Ltd. has spent 14-years conducting exploration, geological and environmental studies, potash (sylvinite) resource delineation, and multiple feasibility studies required for the eventual development of the Udon South and Udon North potash deposits.

The development of the Udon sylvinite deposits could play an important role not only towards improving the
social economic conditions of the province and in particular the Tambons that cover the resource but also reverse the Kingdom’s current dependency on foreign imports of potassium-type fertilizer and industrial-grade potassium products. A sustainable potash mining industry in which Thailand could lead all of Asia for many generations is in reach. However the concept of developing underground mines, in this case for potash appears to remain an enigma. There remains the need for better understanding and appreciation of a unique geological regime that Northeast Thailand is blessed and the will of Thai people to adopt an underground mining project. The Udon South Potash Project has the potential to end Thailand’s dependence on potassium-type fertilizer imports while promoting a sustainable and sufficient economy in the fertilizer industry sector. Simultaneously, the project could improve the social-economic conditions of a region poor in most natural resources but retaining a very unique mineral resource in the form of sylvinite (potash).

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