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POTENTIAL OF WHITE MARBLE RESOURCES IN LUC YEN DISTRICT, YEN BAI PROVINCE OF VIETNAM AND ORIENTATION FOR DEVELOPMENT

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INTRODUCTION

Overview

- White marble - known as white limestone, it is one of the giant mineral resources of Vietnam;
- In Vietnam, there are two well-known geological regions that has been interested by scientific researchers and investors because of its value in use and highly economic efficiency;
- White marble resources of Vietnam is about of tens of billion tons consist of calcium carbonate and hundreds of million cubic meters of blocks;
- White marble of Vietnam is good quality for fields of block, slab marble construction production, calcium carbonate powder and high-end jewelry.

INTRODUCTION

White marble location map of Vietnam

- Two main region:
 - **Yen Bai province**
(northwest of Vietnam)
 - **Nghe An province**
(central of Vietnam)



REGIONAL GEOLOGY

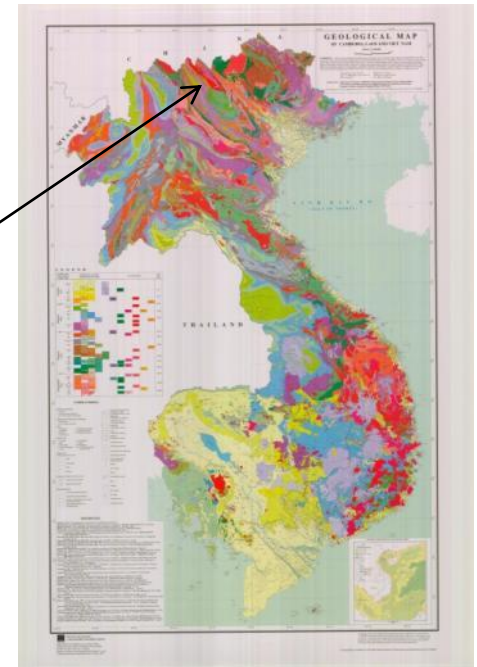
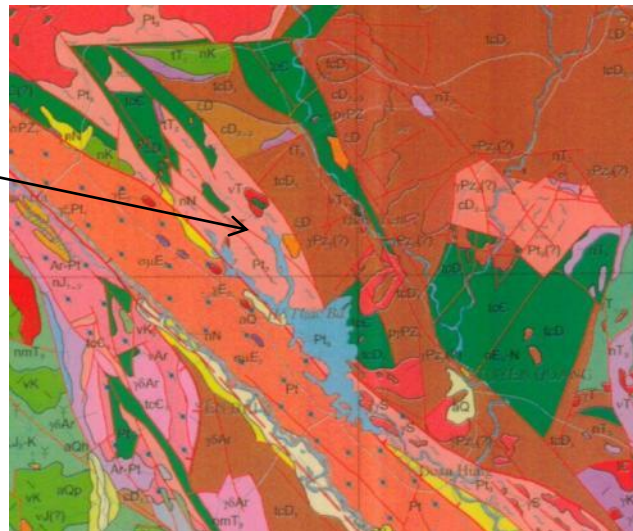
History

- Regional Geology has been researched by Vietnamese and foreign geologists since 1965 at different scales:
 - Regional geological research at 1:500,000 and 1:200,000 scale;
 - Mineral investigation and prospecting works at 1:50,000 and 1:10,000 scale;
 - and particularly many limestone exploration projects have been carried out recently.

REGIONAL GEOLOGY

Structure

- The geological structure is not so complicated:
 - The marble formation belongs to metamorphic limestone range, extended by NW-SE direction, and formed marble rocks;
 - The major fault systems is in NW - SE and the secondary system faults in NE - SW or in sub-meridional direction



Geological map of Cambodia, Laos & 2 Vietnam VIGMR, 2009

REGIONAL GEOLOGY

Stratigraphy & Magma

- Mainly the metamorphic rocks of Thac Ba formation and covered by the marble limestone rocks named An Phu formation (NP - ε1 ap);
- The followings are consists of the sericite - quartz schist, thin limestone layers, and shale of Mia Le formation, a little of unconsolidated Quaternary materials in the valleys and along the streams.
- The intrusions consist of syenite, granosyenite of Phia Ma complex and granite, granodiorite of Phia Bioc complex.

REGIONAL GEOLOGY

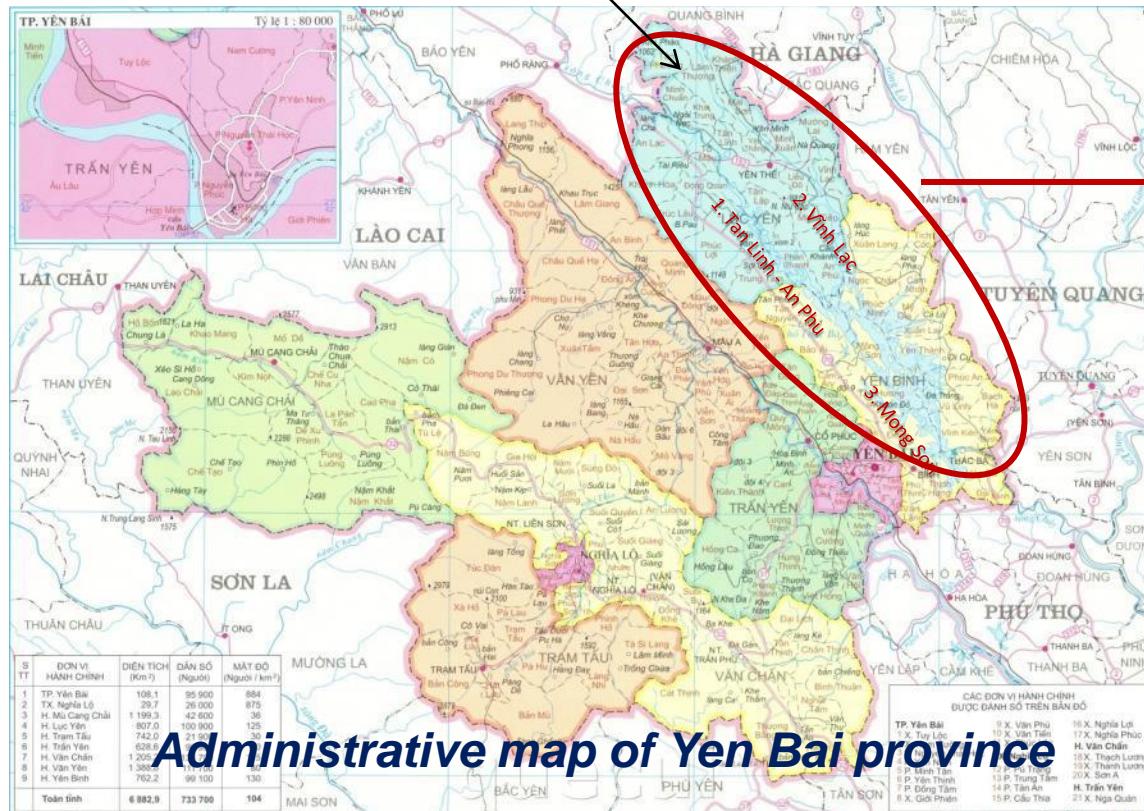
Minerals

- The main minerals in Luc Yen (Yen Bai province) are gem-stone and white marble;
- It is one of the great potential regions of white marble of Vietnam.
- White marble in Yen Bai is concentrated distribution in Luc Yen & Yen Binh districts. Consist of three main areas:
 - 1. Tan Linh - An Phu, and
 - 2. Vinh Lac located in Luc Yen district, and
 - 3. Mong Son located in Yen Binh district.

REGIONAL GEOLOGY

Minerals

- Three main areas of white marble in Yen Bai province:



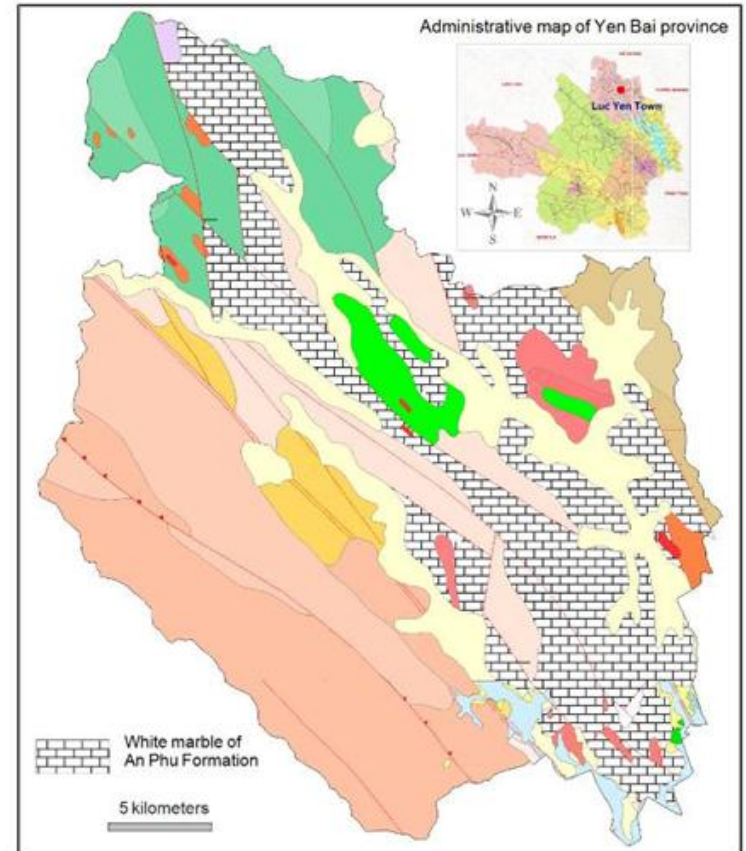
Luc Yen District

Administrative map of Yen Bai province

WHITE MARBLE IN LUC YEN

Geological structure

- White marble formation in Yen Bai named An Phu formation (NP - ε1 ap): Its thickness is about 450-500m;
- Its distribution is variation from 2 to 14 km width, nearly 20 km length in NW – SE direction;
- Structured in single incline formed by:
 - Thick layers of dolomite and calcite marble;
 - With medium to coarse crystals, and disseminated sulfide minerals in some places;
 - Strike and dip of marble layer is about $40^{\circ} \angle 70^{\circ}$



Geological map of Luc Yen area, DGMV 2005

WHITE MARBLE IN LUC YEN

Reserves - Resources

- The marble resources can be used for construction and industrial materials is about 3.9 billion m³;
- up to June 2012, the reserves of 26 exploration projects in area are about 110.044 million m³ of block stone and about 188.992 million tons of calcite carbonate powder;
- The fault systems impacted on the quality of marble caused the recover rate of block stone (> 0,4m³) is about of 66.62% to 97,64% because of stones were strong crushed, cracked and can not use the whole products for paving.

WHITE MARBLE IN LUC YEN

Specification

- The most white limestone potential is in Luc Yen area, distributed in upper subformation of An Phu formations;
- Generally carbonate material has a relatively to high natural white, thick layers or massive form. White and grey white limestone interbedded with gray-white and light pink marble layers;
- Mineral components, mainly are calcite (97% to 100%), graphite (less common, up to 2%), phlogopite (less common, up to 2%). Some places can find forsterite (to 20%);

WHITE MARBLE IN LUC YEN

Specification

- Some indicators of Mechanical and physical properties in average are: brightness of 77.50% to 96.30%, 92.00%, the density is 2.7 g/cm^3 ; saturated compression resistance strength $\geq 500 \text{ kg/cm}^2$; saturated tensile intensity $\geq 39 \text{ kg/cm}^2$; soften coefficient $\geq 0.7\%$; bright coefficient $\geq 90\%$, pH = 9.4, particle size on 325 mesh screen from 0.05 to 4 %, particle size is $3.7 \mu\text{m}$.

WHITE MARBLE IN LUC YEN

Quality and Usage

- Quality of limestone of An Phu formation in Luc Yen meets the requirements of block stones ($\geq 0.4 \text{ m}^3$) for paving and calcium carbonate powder for mineral raw materials of industrial applications;



ORIENTATION FOR DEVELOPMENT

1. Mining and processing Status

- Status of Mining Licenses

Status	Mining	Building	No-Working	Suspending
Mining Licenses	14	9	4	1
Total of Yen Bai province	28 mining licenses			

In which: Luc Yen area had 22 mining licenses and

There were 7 licenses in mining and processing to create products

- Mining methods: The exploiting activities are open-pit in medium and large scale by semi mechanization, diamond wired cutting machines;
- Total of investment capital is over 1,026 billion (about 51 million USD) and use a workforce of 1,290 people

ORIENTATION FOR DEVELOPMENT

1. Mining and processing Status

- Status of production

Yen Bai Province	Block	Powder
Licensed Capacity/year	2 million m ³	13.25 million tons
Output (2010 to Jul 2012)	40,787m ³	5.42 million tons

In which: Production of mining and processing in Luc Yen

Year	Block (m ³)	Slab (m ²)	Chip stone for power (m ³)
2011	10,500	192,000	120,000
2012	20,000	200,000	50,000

- Consumer market: mainly exported to China, India, Malaysia and other countries, a small portion supplied for cement production, carving stone and work of art;
- Difficulties: Capital, Technology, Policies, market

ORIENTATION FOR DEVELOPMENT

2. White Marble Association in Luc Yen

- White Marble Association of Luc Yen was established on July 30th 2012;
- Main objectives of White Marble Association in Luc Yen:
 - Protecting the rights and legitimate interests of its members;
 - Cooperating in mining and processing technology and technique;
 - Support for membership in information relating to market, law and connecting members with the State Management Agencies and Local Communities.

ORIENTATION FOR DEVELOPMENT

3. Orienting the development in the future

- Expand co-operation, exchange specialist inside the Association and to others investors, enterprises and groups;
- Participate in international scientific conference;
- Cooperation to set up processing plants to maximize using and recovery of marble resources;
- Through Luc Yen White Marble Association, enhance and improve abilities of Associations' Members, apply suitable technique and technology to develop white marble industry in Vietnam.

CONCLUSIONS

- Vietnam is a country that there are good geological settings for forming huge limestone resources, in which Yen Bai and Nghe An are 2 provinces owning the most white marble resources of Vietnam.
- White marble resources of Vietnam is quite good for many applications in which Luc Yen (of Yen Bai province) is a most potential region on high quality white marble;
- Yen Bai white marble potential is nearly half Resources and reserves of Vietnam (about 3.9 million m³ for construction and industrial materials);

CONCLUSIONS

- Mining and processing activities on white marble in Luc Yen are developing but there are a lot of things need to do to improve the recent status;
- The Establishment White Marble Association of Luc Yen was a event of great significance for Luc Yen enterprises in particular and for Vietnam white marble sector in general;
- Orienting the development in the future is expanding cooperation, exchange to maximize resources such as finance, technics, technology, management,....

The Government strong encourage for Marble Enterprise to cooperate to the partners who have successful market in Marble Fields.

THANK YOU!