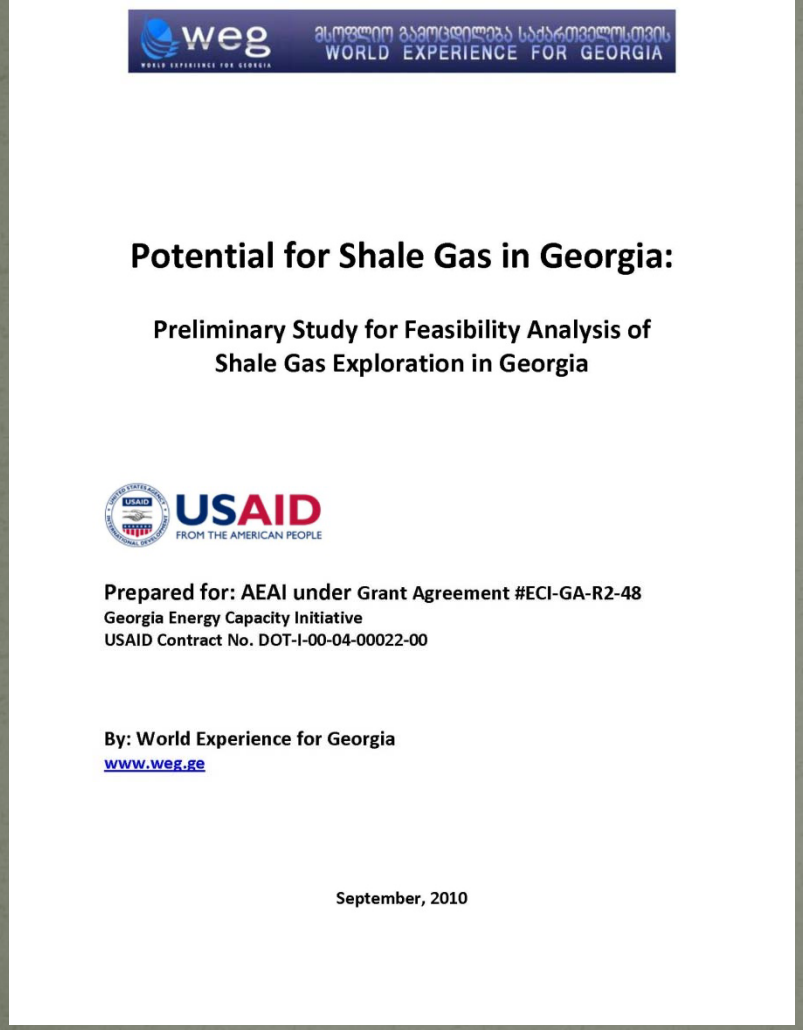
Shale Gas – A Challenge for Georgia

Murman Margvelashvili

GIOGIE 2011



WEG -World Experience for Georgia

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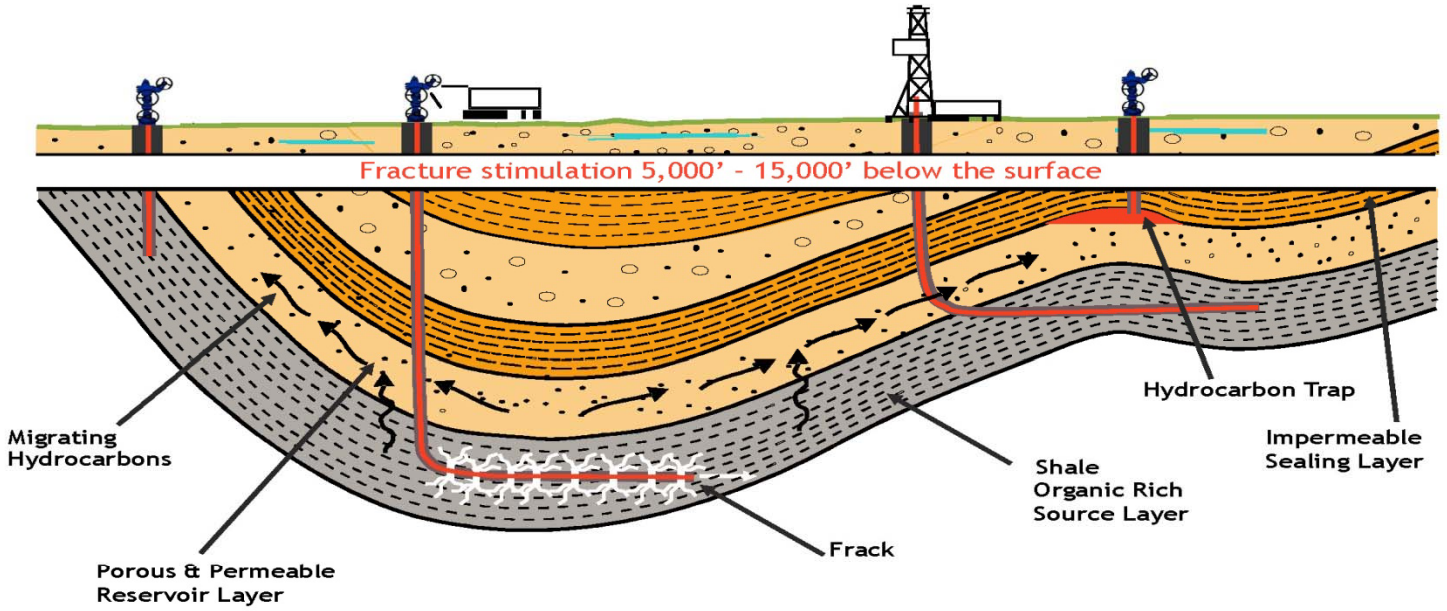
Technology's Role:
Why the Revolution

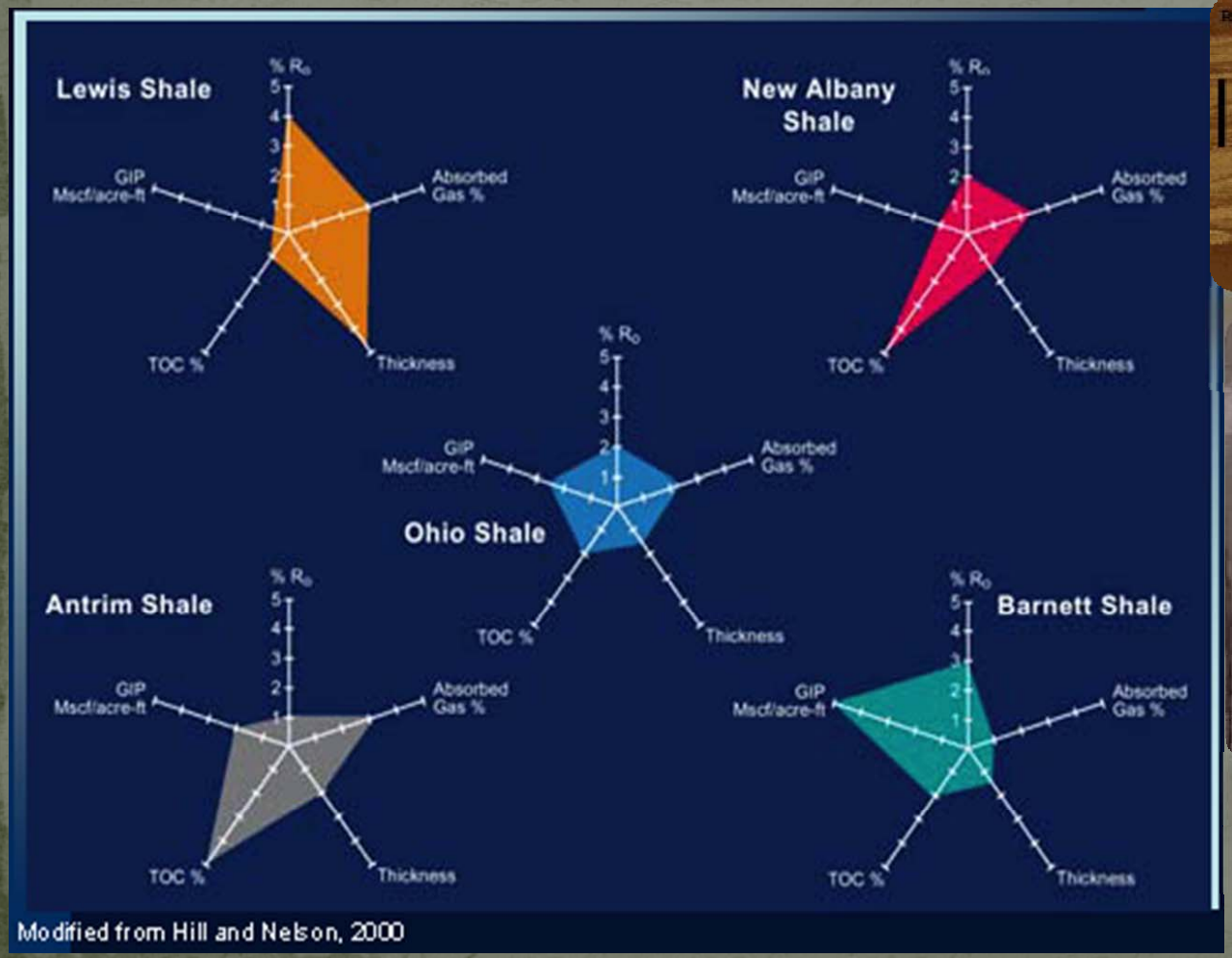
Traps vs. Shales



- Shale gas production -USA, Canada - leaders
- Shale gas exploration is occurring in China, India, Poland, Germany, Spain, France, the United Kingdom, the Netherlands, Australia, Austria, Sweden, Switzerland, Italy, Hungary, Romania, Ukraine, and Argentina.
- Fukushima Increases the importance of fossil resources

“Every Shale is Different”

Halliburton White Paper



Oil/gas bearing formations in Georgia -

East Georgia

#	Complex	Composition	Thickness (m)	Lithology	Area of distribution	Shale
Eastern Georgia						
1	**Lower Pliocene (Shiraki suite)**	Terrigenous	up to 2500	Clays, sandstones, conglomerates	Zonal in South Kakhetian and local in Alazani-Agrichai OGZs	+
2	**Upper Miocene**	Terrigenous	1450-2250	Sandy-clay sediments with interlayers of conglomerates and oolithic limestones	Zonal in Kartli and South Kakhetian and local in Near-Tbilisi OGZs	
3	**Middle Miocene**	Terrigenous	40-600	Clays (shales) with interlayers of sandstones	Zonal in Kartli and South Kakhetian OGZ; local in Near-Tbilisi OGZ	+
4	**Oligocene-Lower Miocene**	Terrigenous	500-1500 and more	Clays (shales) and sandy-clays sediments	Regional (except Achara-Trialeti zone)	+
5	**Upper Eocene**	Terrigenous	100-3000	Clays(?) and shales with interlayers of sandstones	Regional (except Achara-Trialeti zone)	+
6	**Middle Eocene**	Volcanogenic	200-600	Volcanogenic-sedimentary rocks (tuffs, lavas etc.)	Zonal in Near-Tbilisi, Kartli and South Kakhetian OGZs;	
7	**Paleocene-Lower Eocene**	Terrigenous	up to 3500-4000	Sandy-clay sediments with interlayers of limestones and marls	Regional	
8	**Turonian-Danian**	Carboniferous	200-1200	Limestones and marls; lower occur volcanogenic rocks	Regional	
9	**Neokom-Aptian**	Carboniferous	up to 1000-1500	Limestones, marls; locally interlayers of sandstones and volcanogenic rocks	Regional	
10	**Upper Jurassic**	Terrigenous	500-1500 and more	Upper: speckled clays, sandstones; lower: sandy-clays with interlayers of coal-bearing rocks; lowest: volcanogenic rocks	Regional	+
11	**Upper Bajocian-Batonian**	Terrigenous	up to 1000	Alternation of shales and sandstones	Regional (?)	+
12	**Liassic**	Terrigenous	200-1200 maybe more	Shales with interlayers of sandstones and rear interlayers of limestones	Regional	+

(Mgeladze et.al. 1989)

Oil/gas bearing formations in Georgia -

West Georgia

#	Complex	Composition	Thickness (m)	Lithology	Area of distribution	Shale
Western Georgia						
1	**Meothian**	Terrigenous	up to 1000	Conglomerates, clay with interlayers of sandstones	Zonal in Guria OGZ; local in Abkhazeti-Samegrelo and Rioni OGZ	
2	**Upper Miocene**	Terrigenous	up to 2000-2500	Sandy-clay sediments	Zonal in Guria and Abkhazeti-Samegrelo OGZ; local in Rioni OGZ	+
3	**Oligocene-Lower Miocene**	Terrigenous	200-1900	Clays (shales) and sandy-clay sediments	Regional	+
4	**Middle Eocene**	Volcanogenic	1300-4000	Volcanogenic-sedimentary rocks (tuffs, tuff-aleurolites, andesites, basalts, marls etc.)	Zonal in Guria OGZ; and Achara-Imereti OGZ	
5	**Turonian-Danian**	Carboniferous	200-1000	Fractured limestones and marls	Regional	
6	**Neokom-Aptian**	Carboniferous	up to 1000-1200	Limestones, dolomitized limestones and dolomites	Regional	
7	**Upper Jurassic**	Volcanogenic-Terrigenous	up to 2500	In upper part salt-bearing section; lower: sandy-clay sediments; lowest: volcanogenic rocks (albite basalts and dolerites)	Regional	+
8	**Upper Bajocian-Batonian**	Terrigenous	up to 1000	Alternation of shales and sandstones	Regional	+
9	Liassic	Terrigenous	up to 1000	shales with interlayers of sandstones and rear interlayers of limestones	Regional	+

(მგელაძე და სხვ., 1989) მონაცემების გამოყენებით

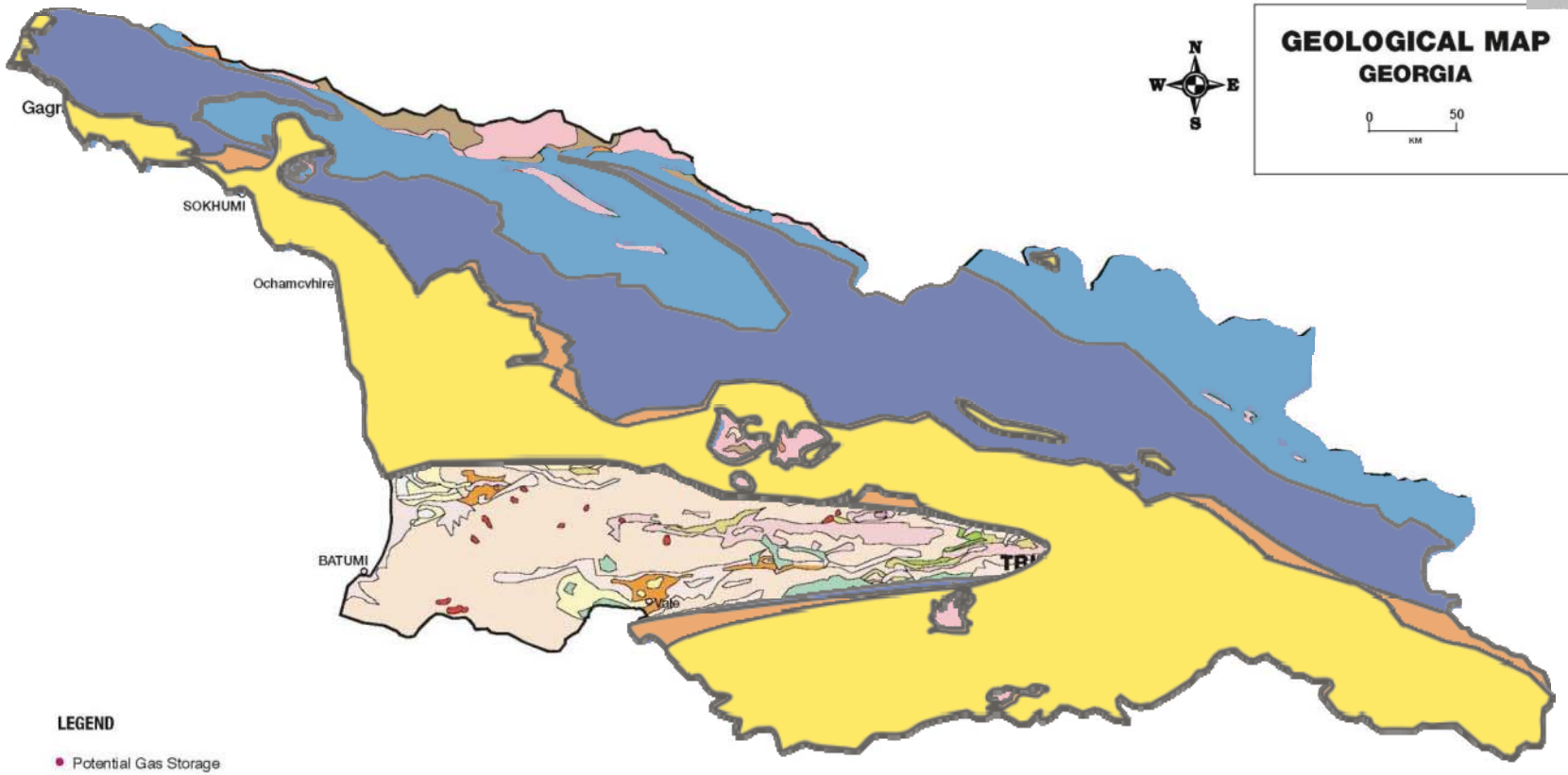
Criteria for Selection

- Oil and gas source beds with known
  - Shale lithology
  - Low permeability
  - Evidence of gas
  - Geographic spread,
  - Thickness
  - Relative homogeneity

- TOC, GIP, Thermal Maturity, etc. not used for evaluation

Prospective Shale Gas Formations in Georgia

Shale Formation	Depth min/max	Thickness min/max	Maturity	Distribution	Tectonics	Lithology	Gas & Oil Shows	Level of knowledge
Upper Miocene (Sarmatian)	0/3,000	300/3,000	matured	Zonal in: Kartli and South Kakheti, Guria and Abkhazeti-Samegrelo, OGZs; local in Rioni and Near-Tbilisi OGZs	Low	sandy-clay sediments with interlayers of conglomerates and oolithic limestones	Oil shows	Intermediate
Oligocene-Lower Miocene (Maikopian)	0/>5,000	700/2,500	matured	Regional	Intermediate	clays (shales) and sandy-clays sediments	Oil & Gas shows	Good
Middle Jurassic Aalenian-Bathonian	0/>9,000	400/1,300	matured	Regional	Tectonized with vertical and overturned folding, overthrusts bedding and thrust faults	alternation of shales and sandstones	Oil	Poor- intermediate
Lower Jurassic (Liassic)	0/>10,000	200/1,500	matured-over-matured	Regional	Same as above but more tectonized	shales and slates with interlayers of sandstones and rear interlayers of limestones	Oil shows, bitumen	Poor-intermediate


GEOLOGICAL MAP
GEORGIA
0
50
KM
N
W
E
S
Gagr
SOKHUMI
Ochamchire
BATUMI
Kvale
LEGEND
Potential Gas Storage
Potential Aquifer Gas Storage Site
Q Quarternary individed sediments, shingle, sand,clay.
Q1 Chaudian and Bakunian layers, shingle, sand, clay.
N2 Entire Pliocene. Conglomerate, sandstones, clay.
N1-N2 Miopliocene, conglomerate, sandstones, clays, andesite-dacites and their pyroclastolythes.
N1 Upper Miocene. Clays, marl sandstones, conglomerate.
N1 Middle Miocene. Sandstones, clays, limestones, conglomerate.
Pg+N1 Oligocene-Lower Miocene. Clays, sandstones, (Maykopian suite)
Pg3 Upper Eocene. Clays, marl sandstones, rare volcanogenic formations.
Pg2 Middle Eocene. Andesite bazalt and their pyroclastolythes.
Pg+ Pg2 Paleocene-Eocene. Limestones, marl
Pg+ Pg1 Paleocene-Lower Eocene. Clays, marl, sandstones (flysch).
Cr Entire Cretaceous. Limestones, marl, rare volcanogenic formations.
Cr2 Upper Cretaceous limestones, marl, sandstones, volcanogenic formations.
Cr1 Lower Cretaceous limestones, dolomitized limestones, marl, sandstones.
J3 Upper Jurassic. Limestones, mare, clays, sandstones, conglomerate.
J2 Middle Jurassic. Porphyrites and their pyroclastolythes, sandstones, shale stones.
J1 Lower Jurassic, shale, rare limestones.
Pz+T Upper Paleozoic-Triassic, shale, quartzites.
Pz3 Upper Paleozoic, oxidized volcanic formations.
Pz1 Lower Paleozoic (Cambrian-Devorian), metamorphic slates.
PCm+Pz Pre-Cambrian and Lower Paleozoic crystaline slates.
Pliocene-quarternary andesites, dolerites, basalts, dacites.
Paleogenic syenites and diorites.
Middle Jurassic granitoids.
pz Paleozoic granitoids.
Stratigraphic and intrusive contact boundary

Scale of the Game

- Numerous gas shows
- Formations oil prone, type II kerogen, favorable for Shale Gas
- High thickness of formations

- **Exercise**

Lower Jurassic (Liassic) – South slope of Caucasus - Kazbegi Lagodekhi

Assume for - 1000km^2=30kmx33km

- 400m net thickness out of .3-1.5km (Cf. 20-60m in Barnett)
- Gas content 5cm/ton (9cm/ton in Barnett)
- 10% recovery rate (min-12% in New Albany)

500bcm potential recoverable reserve from one formation

THE STAKES ARE HIGH

Challenges

1.Information availability and quality

- Geology Information in different institutions
- Well log data from different license block owners
- Measurement methodologies to be revisited
- Availability of information very low

Data consolidation, digitization and reconciliation and more surveys needed

2. Technology, know-how

No experience with shale gas among policymakers and operators

Some experience with directional drilling and hydro fracturing

No service companies, drilling industry

Technology transfer and technical assistance should be sought

3. The territory divided into many license blocks

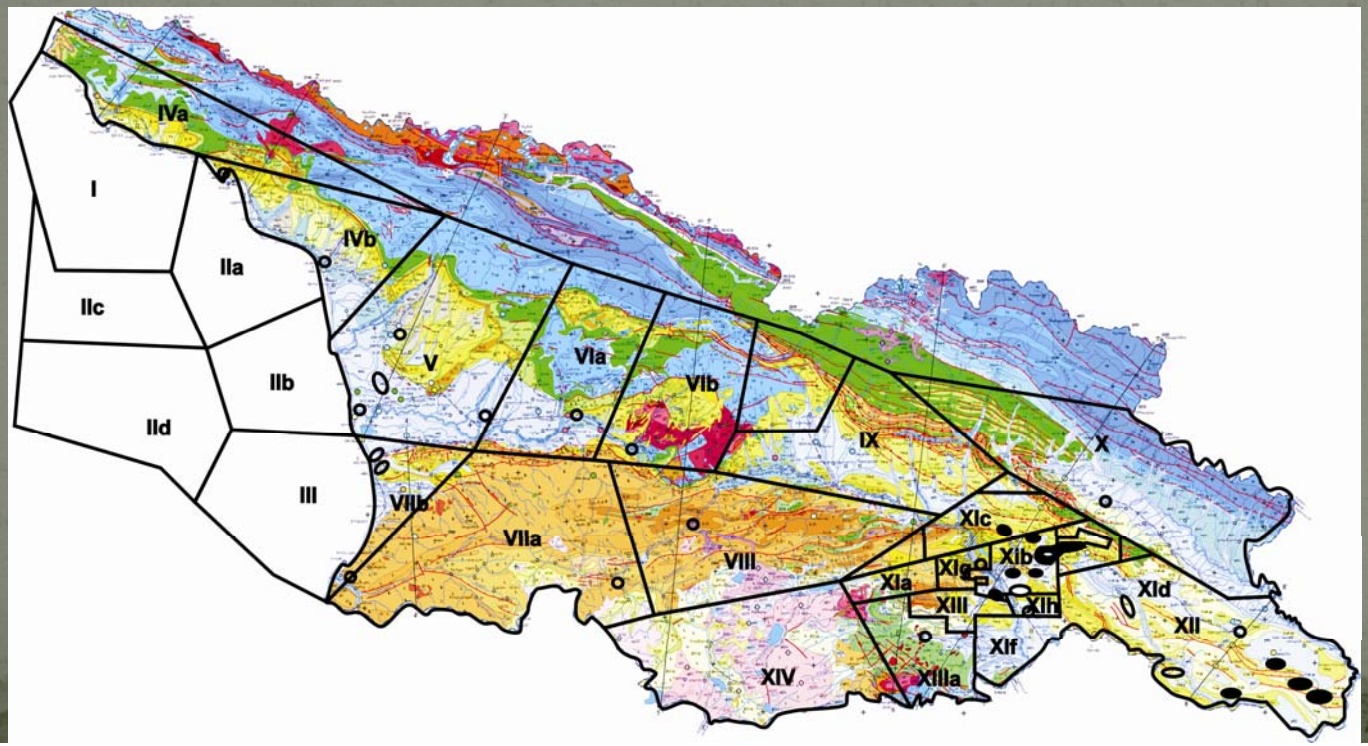
- Licensees may be unprepared or unwilling to take the risks of SG exploration and production development

Information, financial and technological barriers. Need to encourage existing license block owners or bring in new investors. Highly experienced specialized international companies should be involved ***–failure may have highly damaging results***


RUSSIA
BLACK SEA
TURKEY
ARMENIA
AZERBAIJAN
IVa
I
IVb
IIa
IIc
IIb
IId
III
V
VIa
VIb
IX
X
VIIIb
VIIa
VIII
XIV
XIIIa
XIa
XII
Strait Oil & Gas VI^A VI^B
Jindal Petroleum IX-X-XIII^A VII^A
Global Oil & Energy VIII VII^B
Anadarko Georgia II^A II^B III
Ninotsminda Oil XI^E XI^F
Frontera XII
Jindal & Ensearch XI^B
Aksai BMC V
CanArgo-Nazvrevi XIII XI^D
CanArgo-Norio XI^C XI^C XI^D
Norio Oil Company
Territory for bidding
Oil fields
Gas fields

Challenges

- Partly Mountainous Terrain,
  - Land and infrastructure availability
    Pipelines, roads
  - Water available, but - environmental concerns – risk of [illegible] water contamination



Potential Markets for Gas

Internal Market

- SSP strategic planning (WEG – MoE- IRG) shows almost doubling of gas demand by 2030 in reference (BAU) scenario
- Rapid development of free industrial zones may result in more than doubling of gas consumption in next 5-7 years

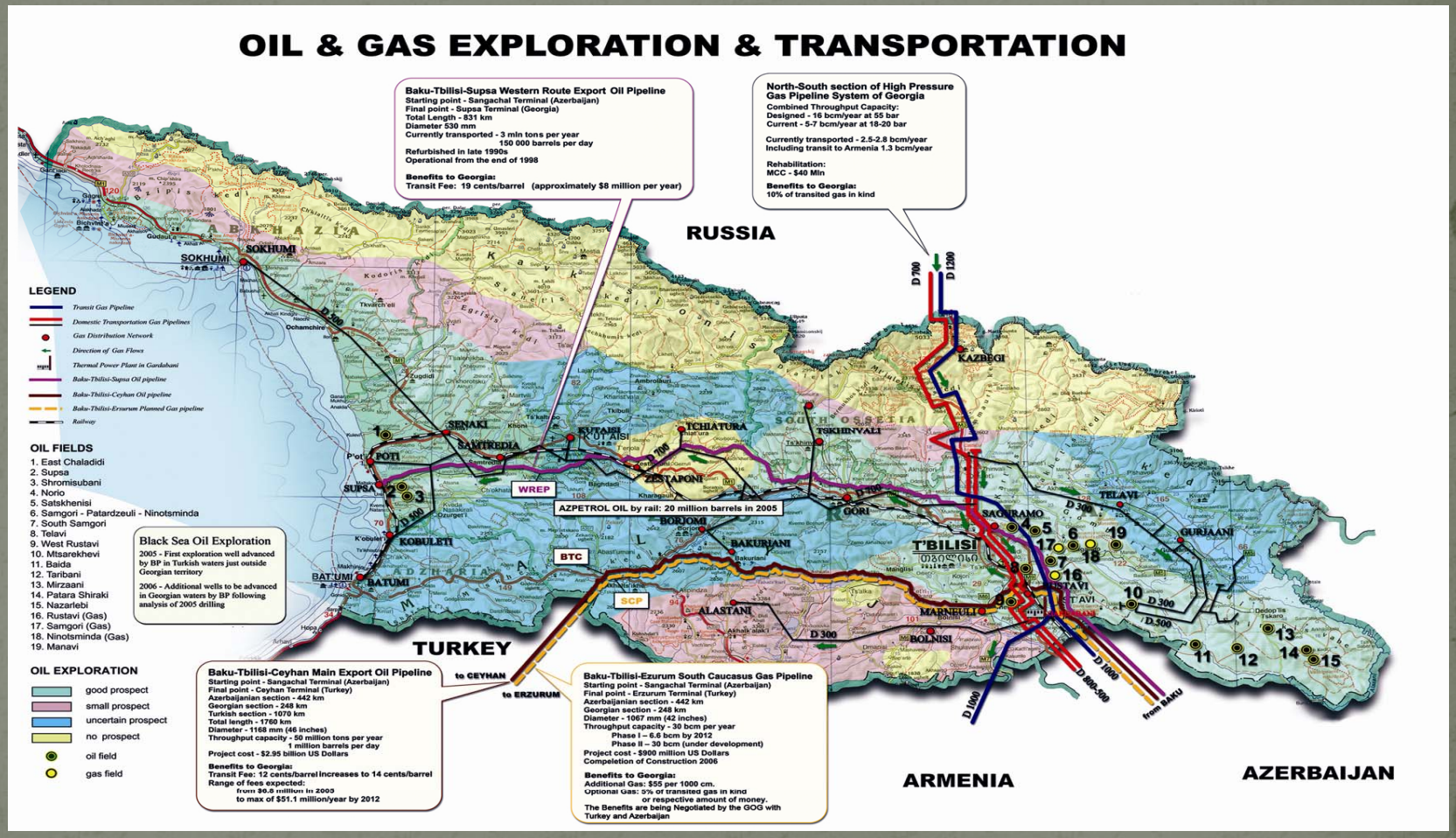
Regional Market

- Fukushima may result in increase for future gas demand in Armenia

International Markets

- Southern Corridor (Nabucco, White Stream, SCP II)
- LNG facility (AGR)

Existing Oil and Gas Pipelines



SG Challenges

- High Production costs & slow development curve
- Price competition with natural gas suppliers and subsidized gas prices on internal market
- Market/network access when network owners are also suppliers and distributors

Develop the Legal and Regulatory measures -

- Examine the possibility for favorable taxation, feed in tariffs, reserved market segment (e.g. CNG vehicles)

- Assure third party access to distribution networks

- Secure access and preserve control of the transmission pipelines

Conclusions

- Shale Gas can be a high potential resource at least of national and regional importance
- Number of important internal and external factors are complicating the development of this resource – *A wise and diligent development strategy is needed*
- Strong external financial, technical and policy support is needed in order to bridge the risks and gaps and develop the shale gas potential

Recommendations

Exploration activities

1. Develop a Central & Unified Geological Data Base for Shale Gas Deposits.
2. Conduct Exploratory Geology Analysis with License Block Operators
3. Compile the Geological Framework Model of Shale Gas in Georgia
4. Shale Gas Resource Screening and Ranking Analysis, Geophysical Surveys of Candidate Shale Gas Play Areas
5. Exploratory Test Drilling and Geological Data Analysis
6. Gas Market, Regulatory and Infrastructure Review
8. Develop Shale Gas strategy and Action Plan

To accomplish the above

1. Negotiate and involve existing and potential new License Block owners,
2. Apply for international assistance and involve highly experienced and professional specialized companies,
3. Develop the local technical and policy capacity for shale gas development.

THANK YOU

www.weg.ge