



# **Oil Reserves Growth Potential**

**F. Harper**

**ASPO 2004**

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# Reserves Growth

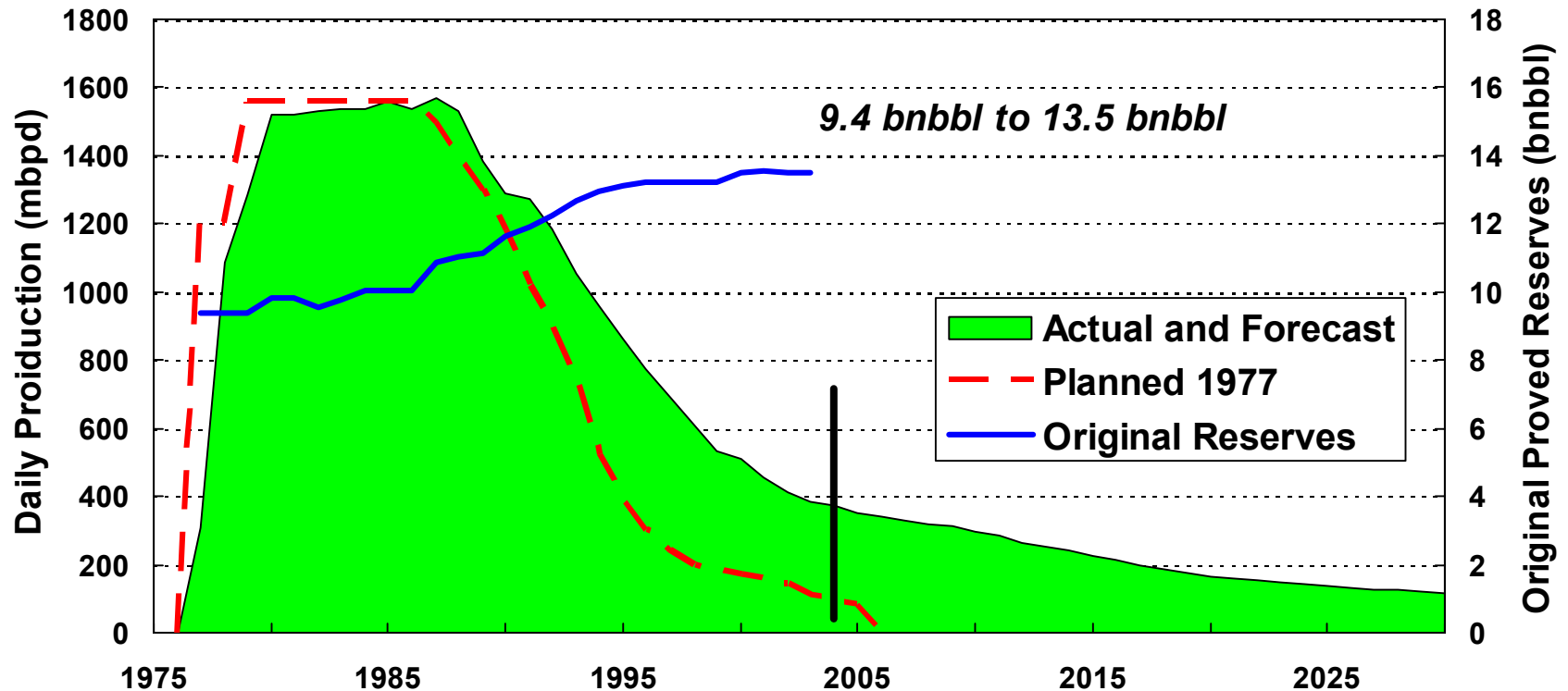
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*The amount by which initial estimates of the reserves in a field or population of fields will (or are expected to) grow with time*

*It is important to distinguish between growth in different categories of reserves (eg proved vs. proved and probable) or under different reporting regimes (eg US vs UK)*

- What are the sources of growth?*
- How do you measure it?*
- What is its magnitude?*

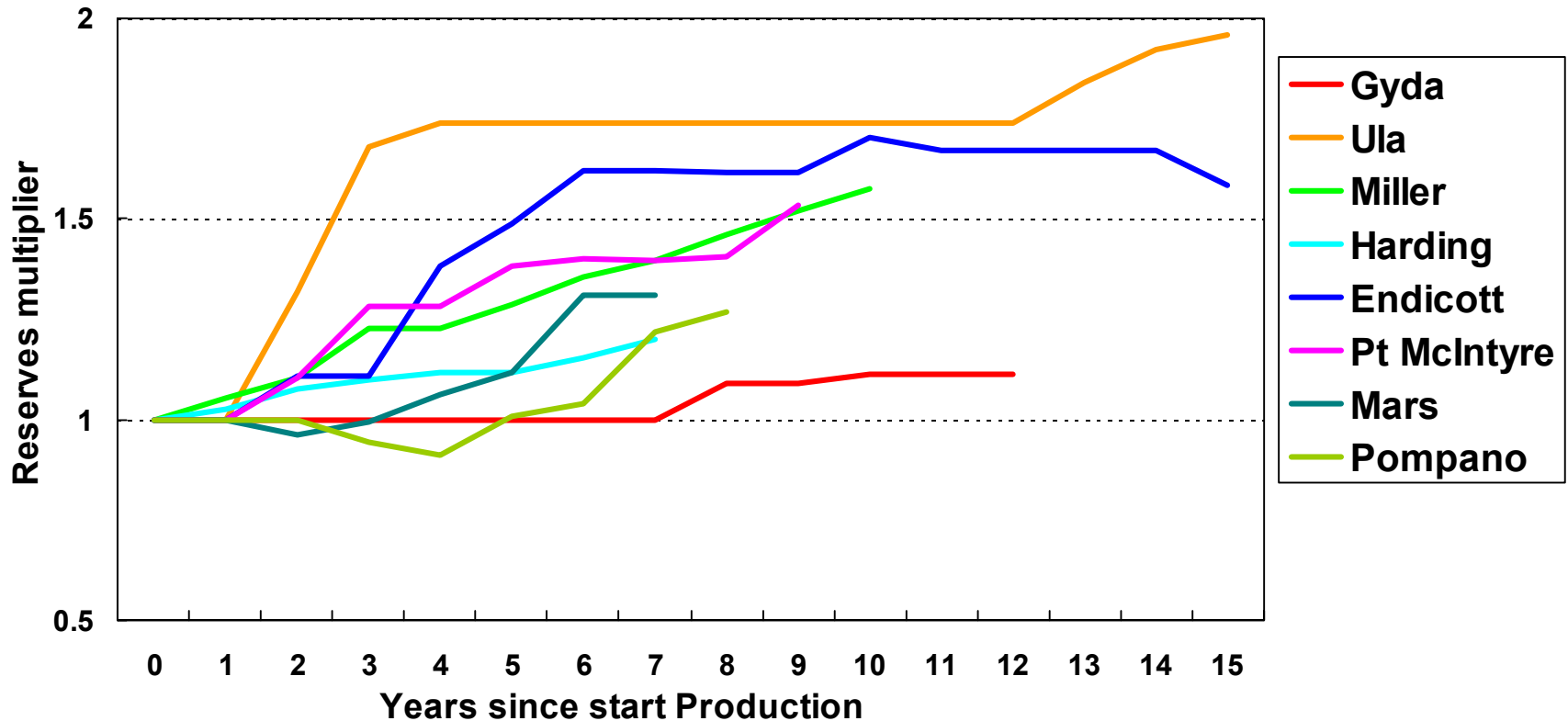
# Reserves Growth – Prudhoe Bay



## Reserves Growth is:

- Typically a factor in mid to late field life
- Expensive
- Measured by comparing prediction with actual

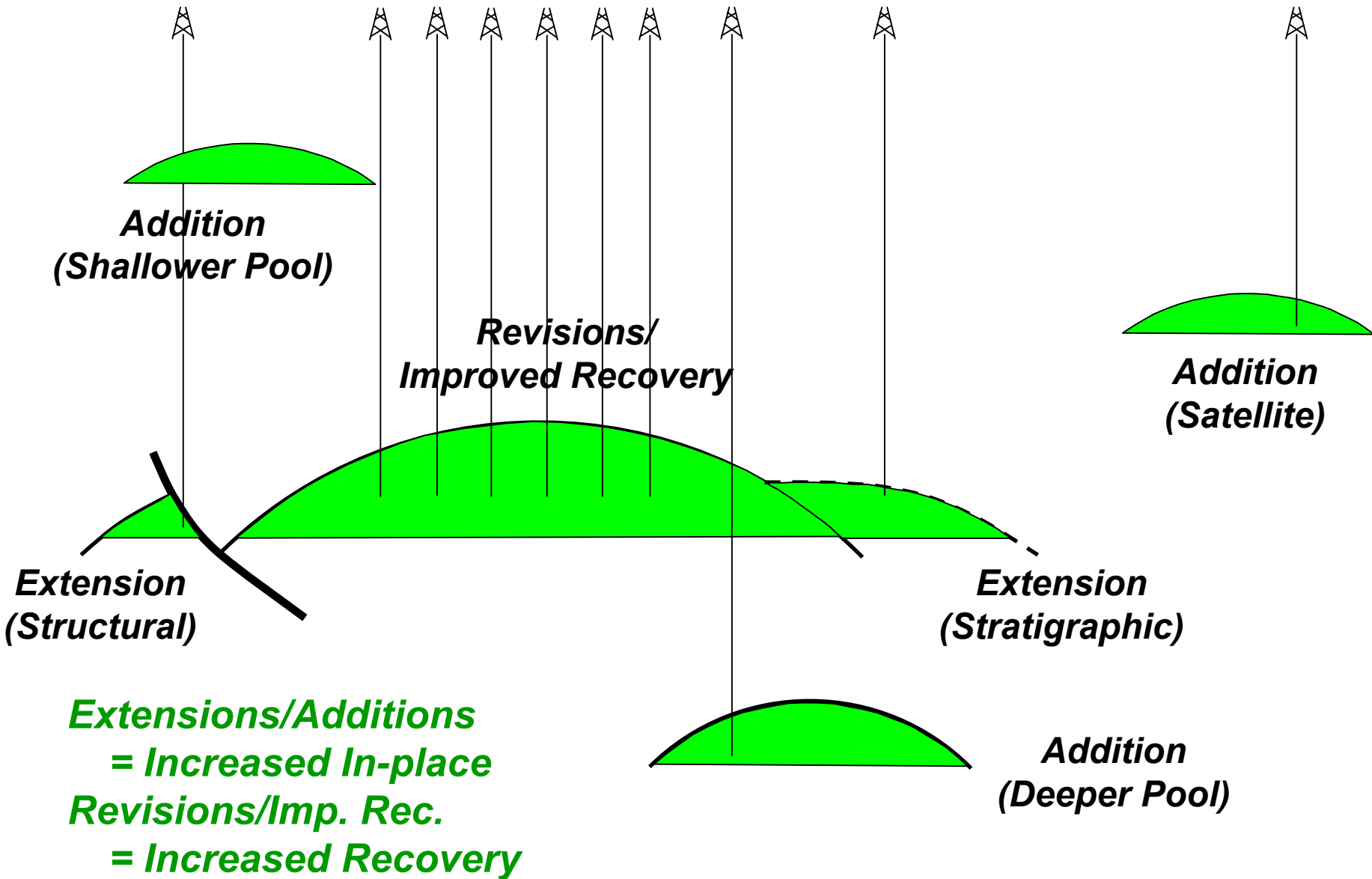
# Reserves Growth – More Fields



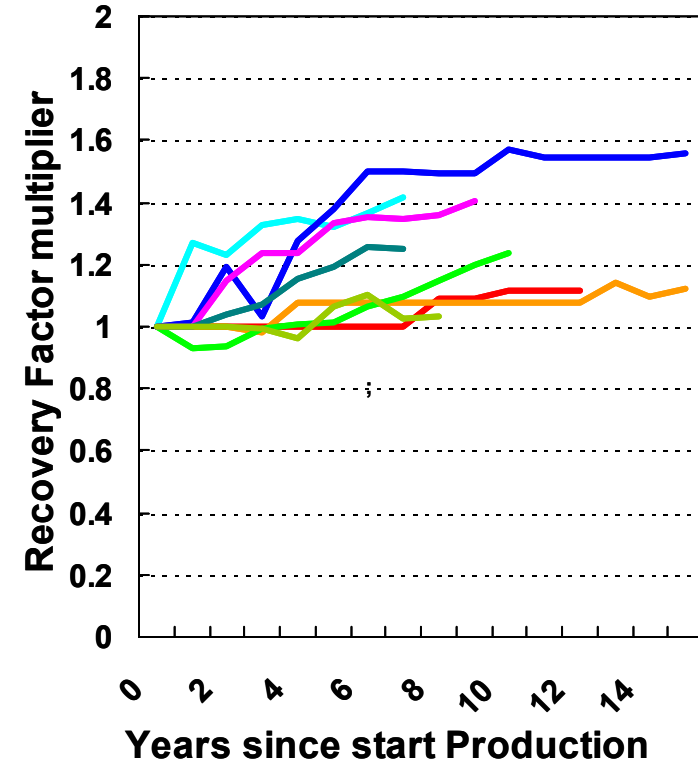
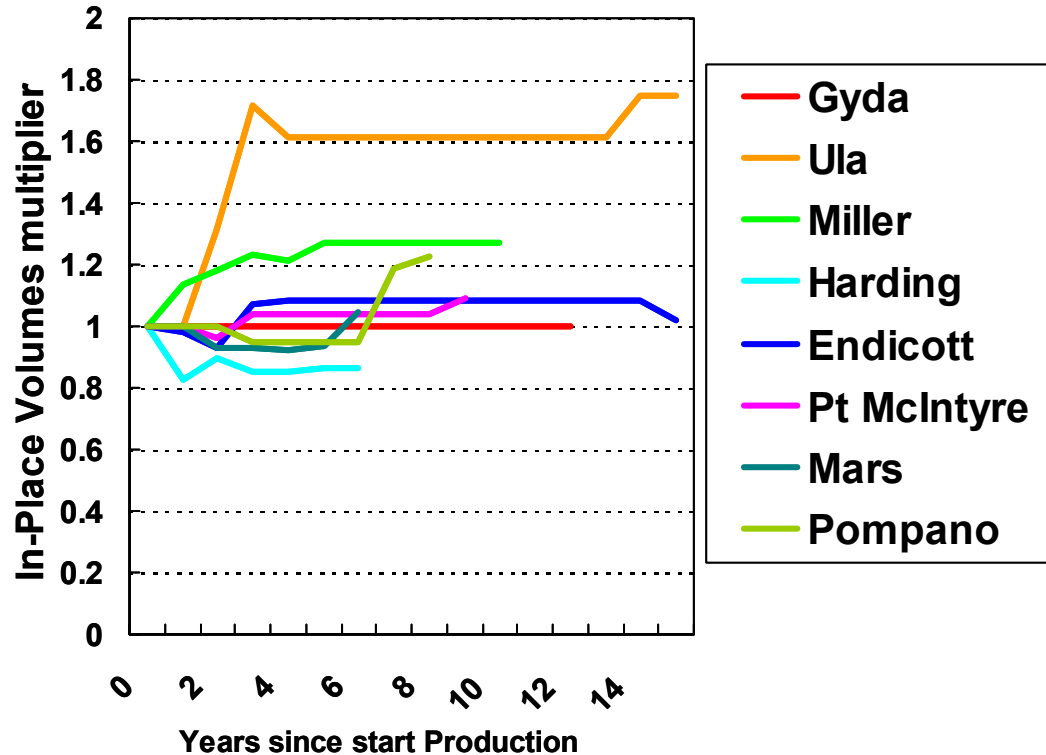
## Reserves Growth is:

- Variable (and may be negative)
- Not necessarily restricted to late field life
- More difficult in deepwater environments

# Sources of Reserves Growth



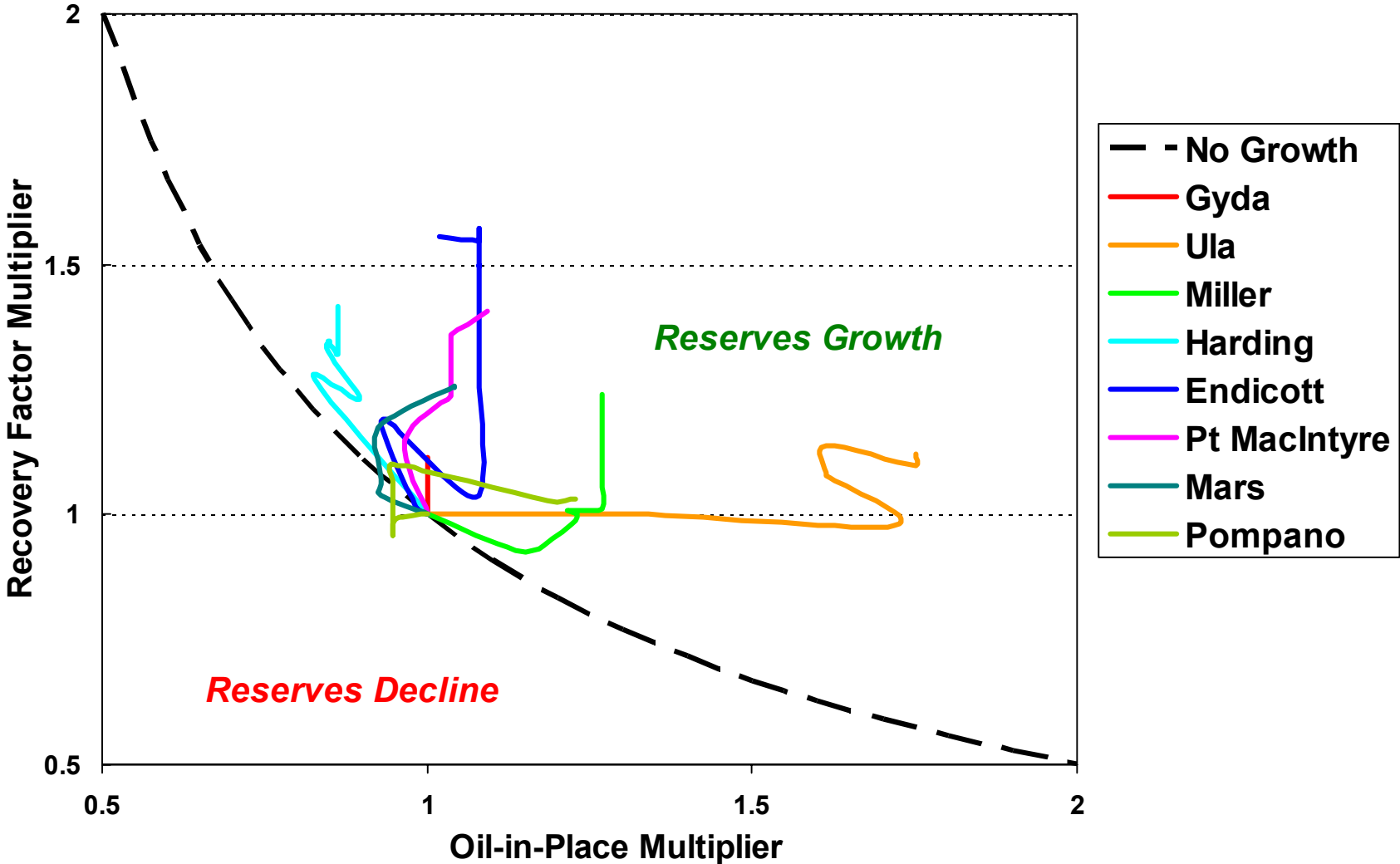
# The Roles of In-Place and Recovery



## Reserves Growth is:

- A combination of in-place and recovery changes
- Often attributed primarily to recovery increase since in-place volumes are studied less frequently

# Combining In-place and Recovery effects



# EIA discovery estimates for L48 – '77-'91

		Year of Estimate														
		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Year of Discovery	1970	798	820	833	899	998	1069	1094	1128	1151	1228	1237	1256	1261	1273	1293
	1971	561	<del>583</del>	<del>567</del>	<del>589</del>	<del>609</del>	<del>647</del>	<del>699</del>	<del>702</del>	<del>720</del>	<del>735</del>	<del>754</del>	<del>770</del>	<del>777</del>	<del>803</del>	835
	1972	438	457	458	487	506	526	541	560	589	596	607	658	670	710	676
	1973	392	424	460	508	623	615	639	698	743	768	787	807	835	851	852
	1974	423	474	494	539	612	621	653	680	700	705	741	840	778	805	809
	1975	311	339	451	504	506	519	576	616	672	686	708	732	786	831	836
	1976	344	440	503	698	710	711	747	807	798	829	852	856	857	880	906
	1977	110	<del>171</del>	<del>221</del>	<del>264</del>	<del>376</del>	<del>385</del>	<del>393</del>	<del>428</del>	<del>452</del>	<del>458</del>	<del>465</del>	<del>489</del>	<del>557</del>	<del>589</del>	584
	1978		45	87	113	140	146	172	190	216	217	222	227	235	241	256
	1979			77	217	394	432	479	475	470	510	517	559	589	608	603
	1980				59	151	178	211	244	246	252	267	295	314	332	350
	1981					91	282	353	390	467	474	502	557	587	667	706
	1982						120	209	241	264	261	269	292	307	336	335
	1983							97	219	406	307	332	329	345	374	397
	1984								103	179	212	224	248	272	282	301
	1985									111	192	224	258	264	284	303
	1986										35	<del>71</del>	<del>81</del>	<del>89</del>	<del>93</del>	98
	1987											45	90	214	232	235
	1988												44	90	100	107
1989													38	74	95	
1990														37	79	
1991															97	

Data from EIA database to '91 (Attanasi & Root '94)

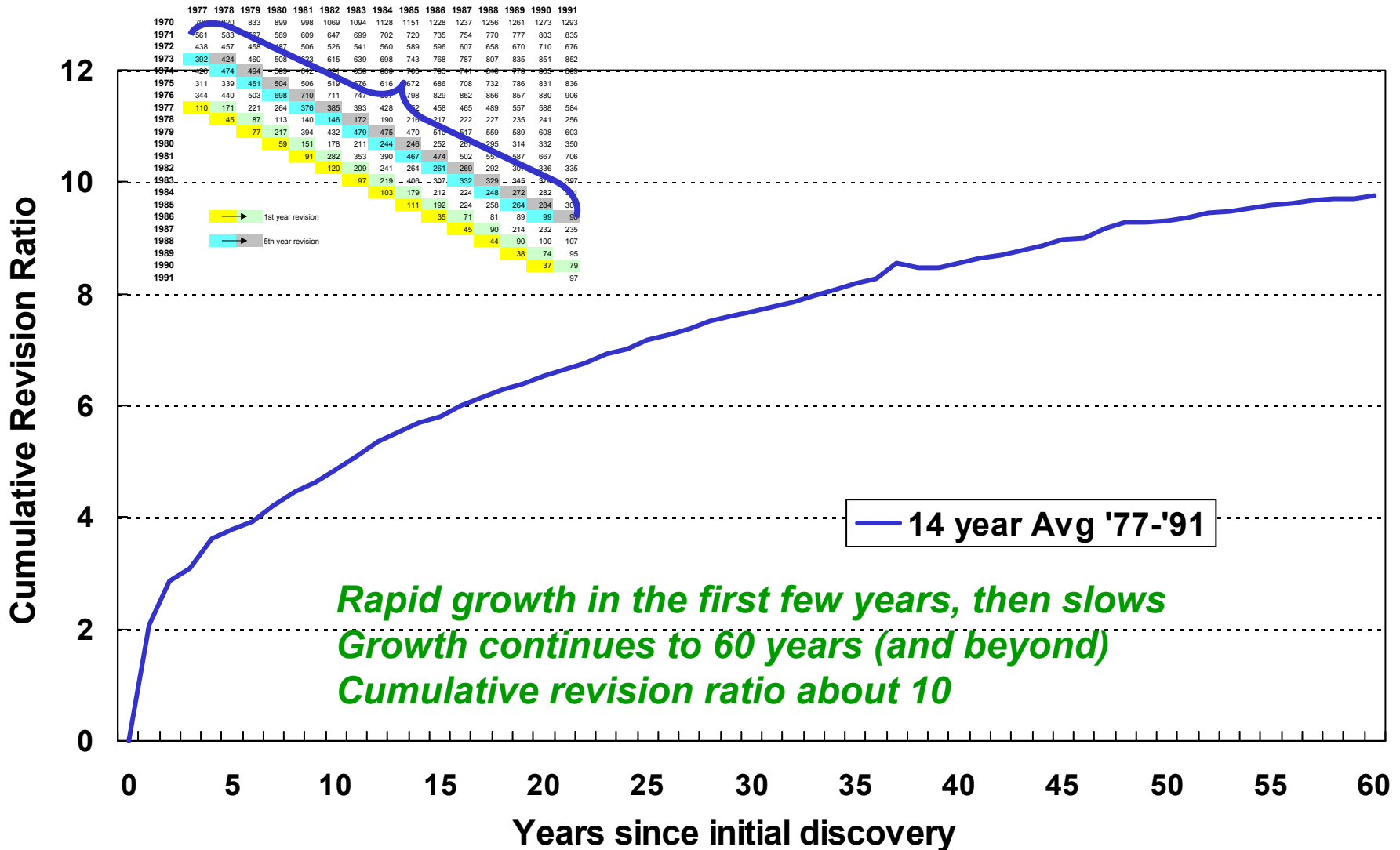


# EIA estimates – Arrington approach

		Year of Estimate															
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Year of Discovery	1970	798	820	833	899	998	1069	1094	1128	1151	1228	1237	1256	1261	1273	1293	
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	1985									111	192	224	258	264	284	303	
	1986											35	71	81	89	99	98
	1987												45	90	214	232	235
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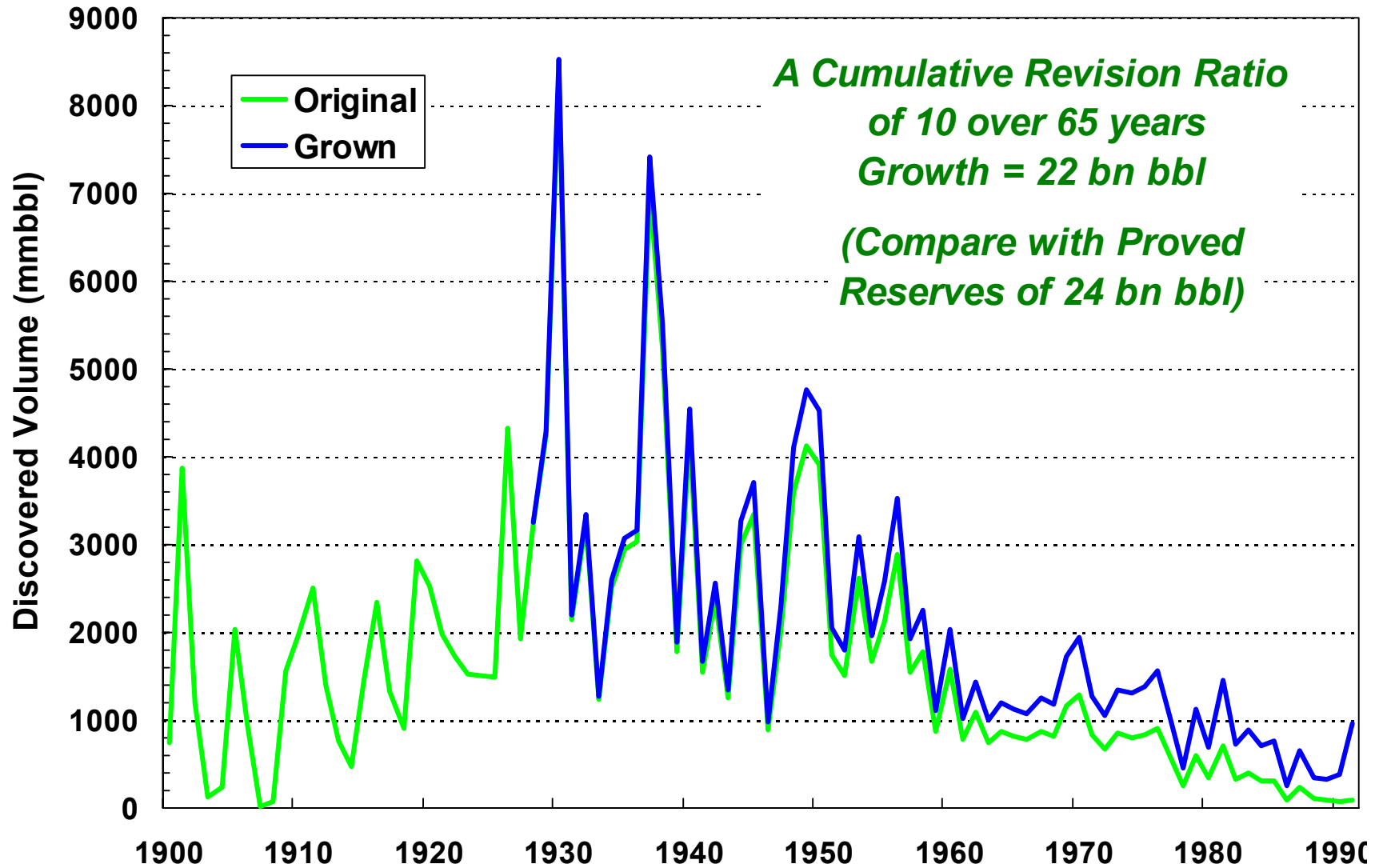
Data from EIA database to '91 (Attanasi & Root '94)

# Reserves Growth – USA Oil

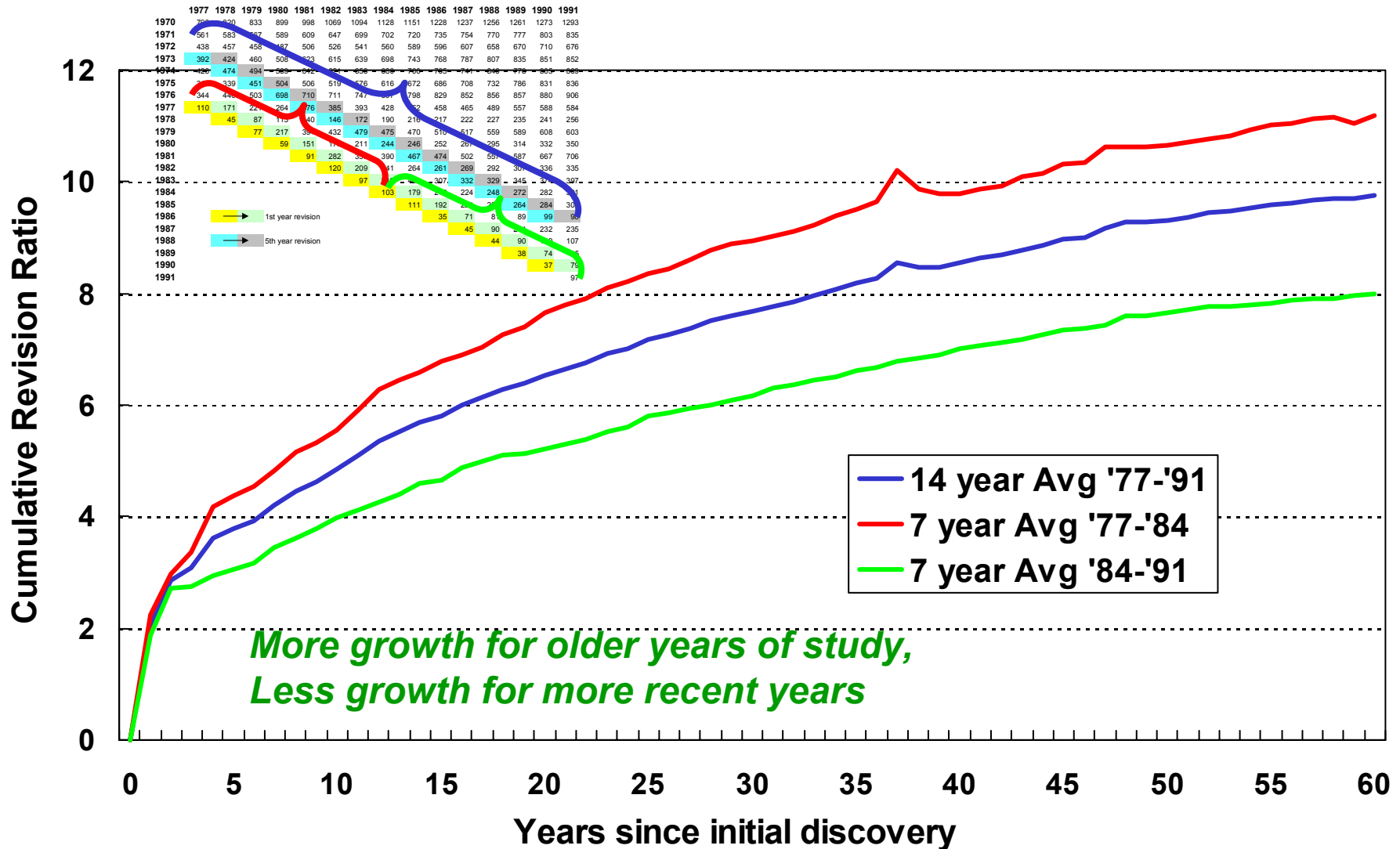


Data from EIA database to '91 (Attanasi & Root '94)

# Reserves Growth – USA Oil

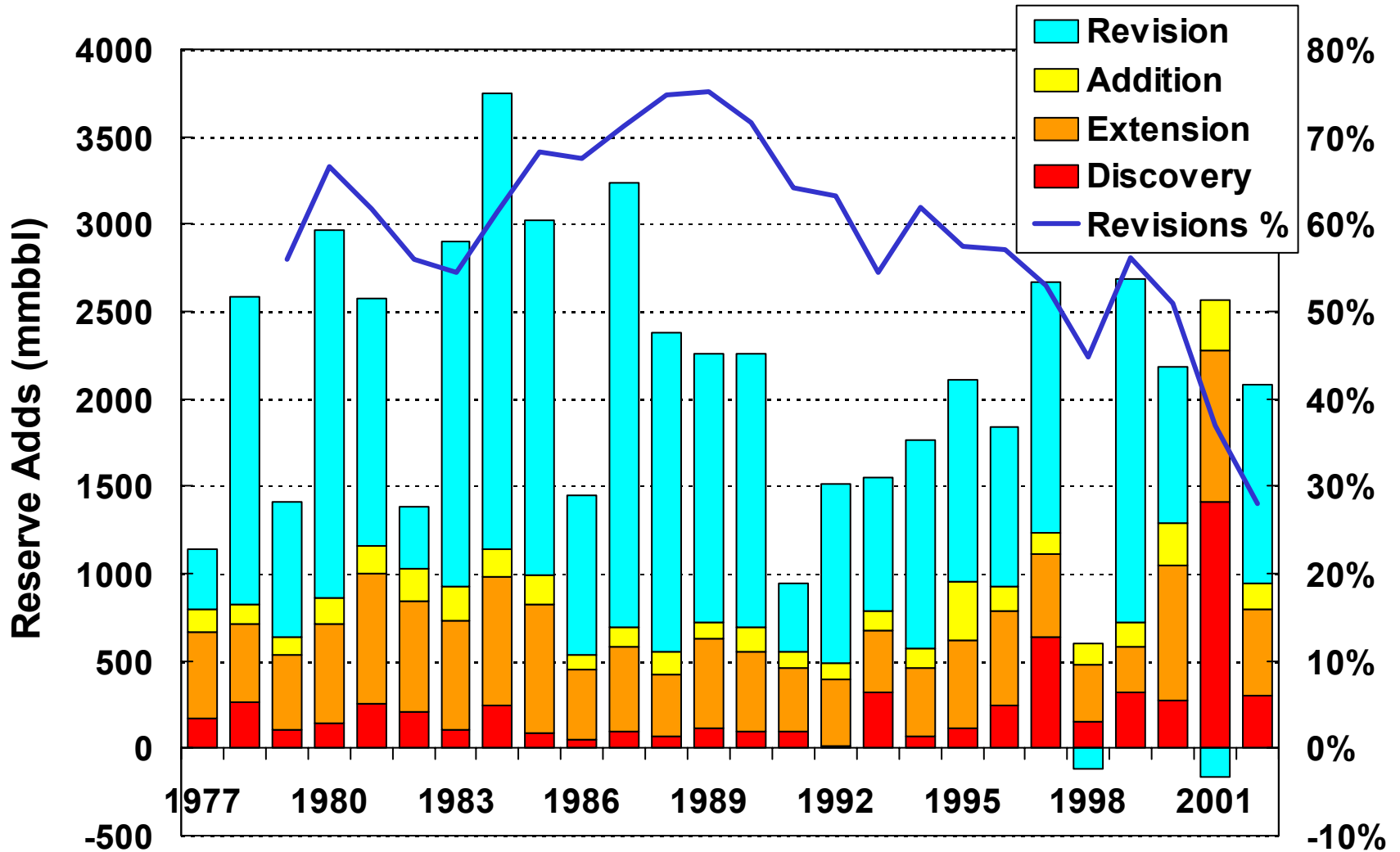


# Reserves Growth – USA Oil



Data from EIA database to '91 (Attanasi & Root '94)

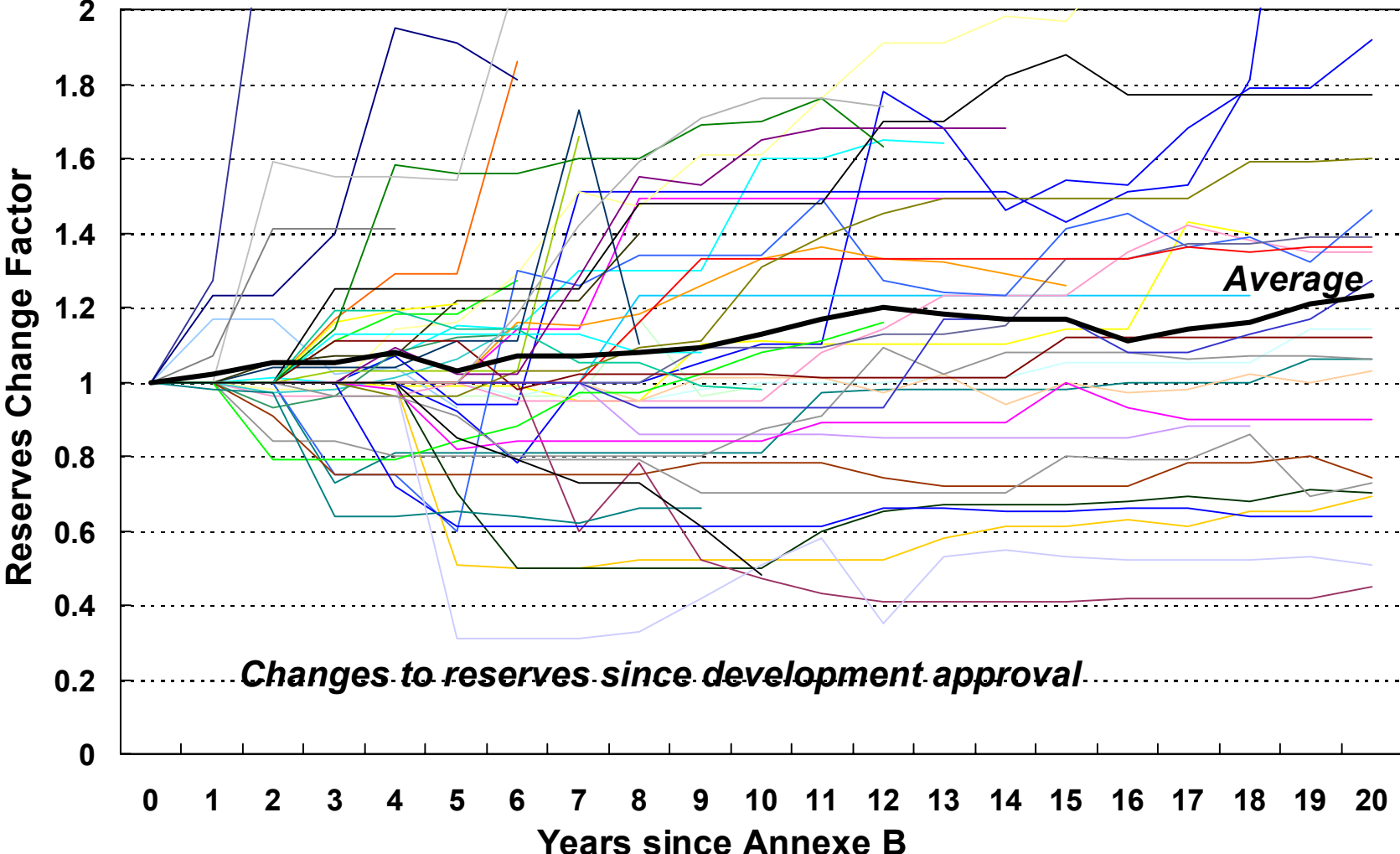
# Proved Reserve Additions – USA Oil



Data from EIA annual reports

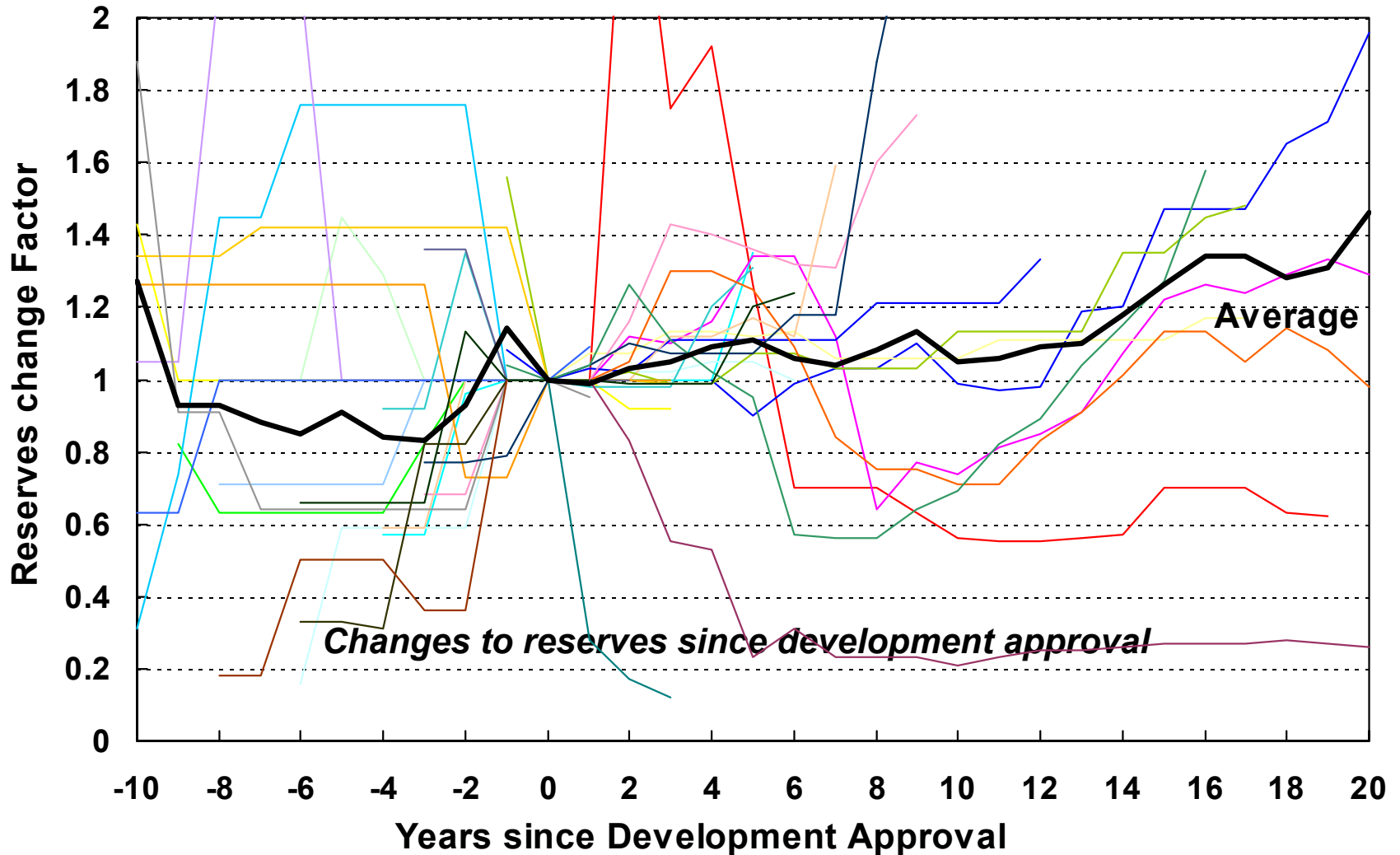
Revisions % on a 3-year rolling average

# Oil Reserves Changes by Field - UK

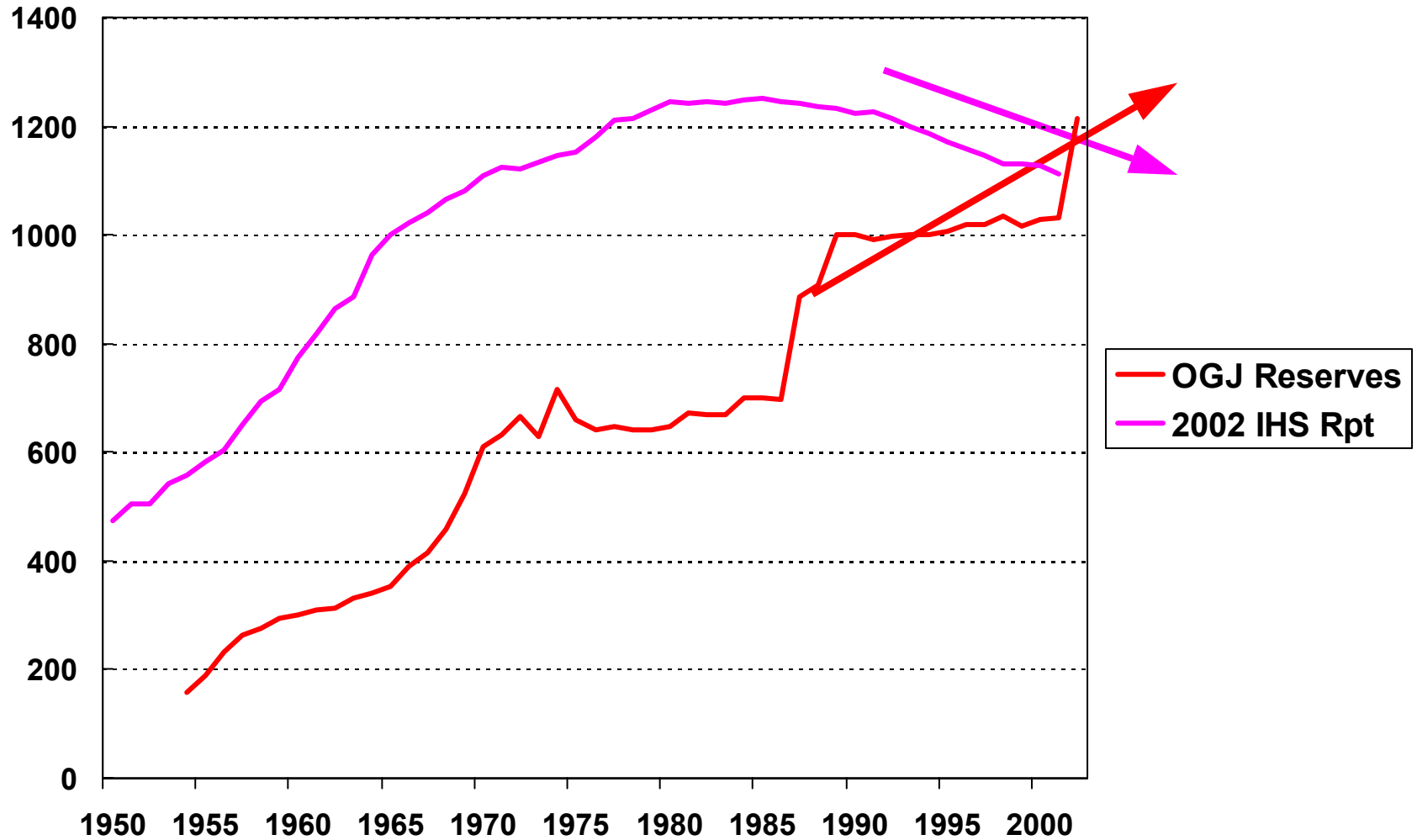


Data from DTI annual "Brown Book" reports

# Oil Reserves Changes by Field - Norway



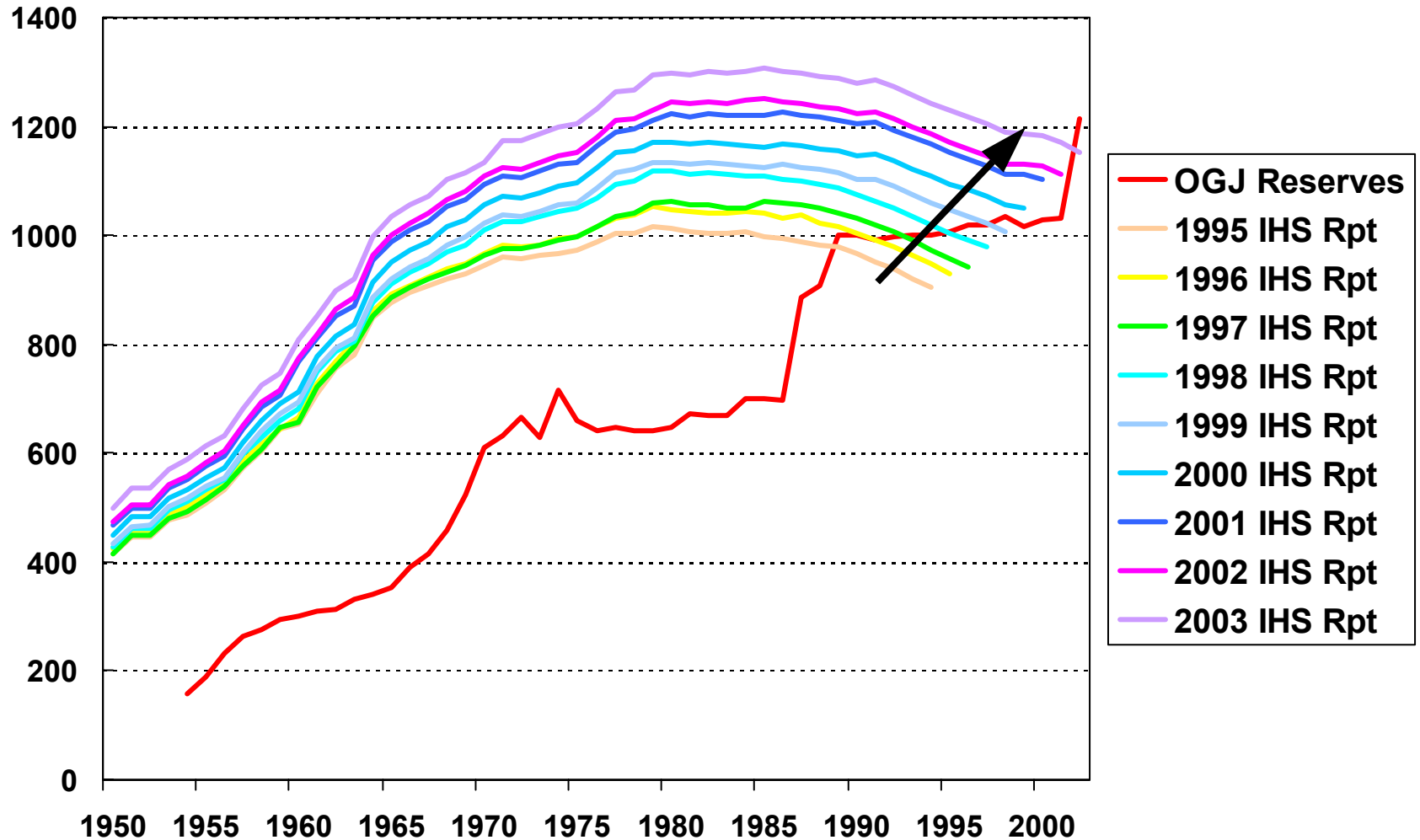
# IHS and OGJ Remaining Reserves



Data from IHS Energy and OGJ annual reports

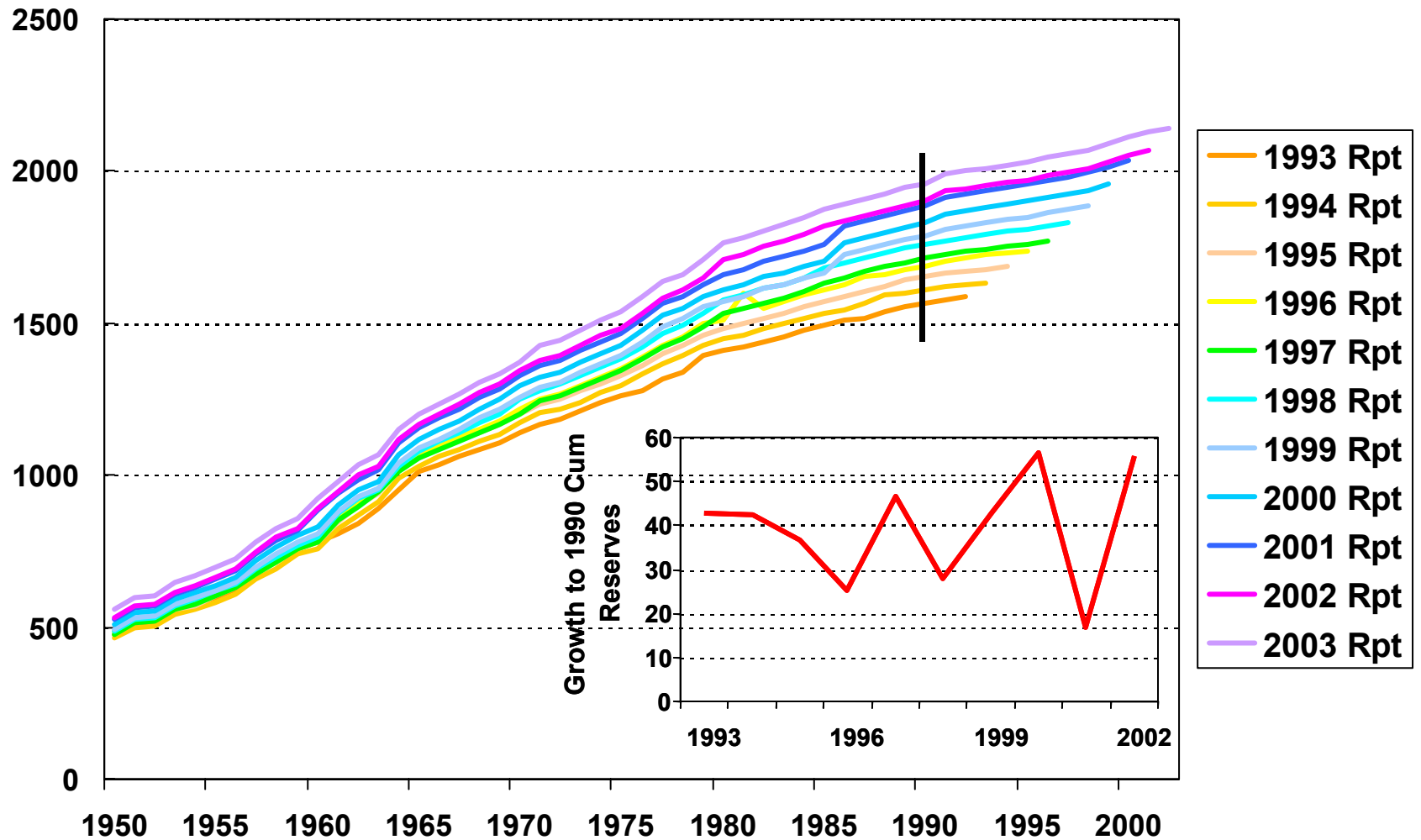


# IHS and OGJ Remaining Reserves



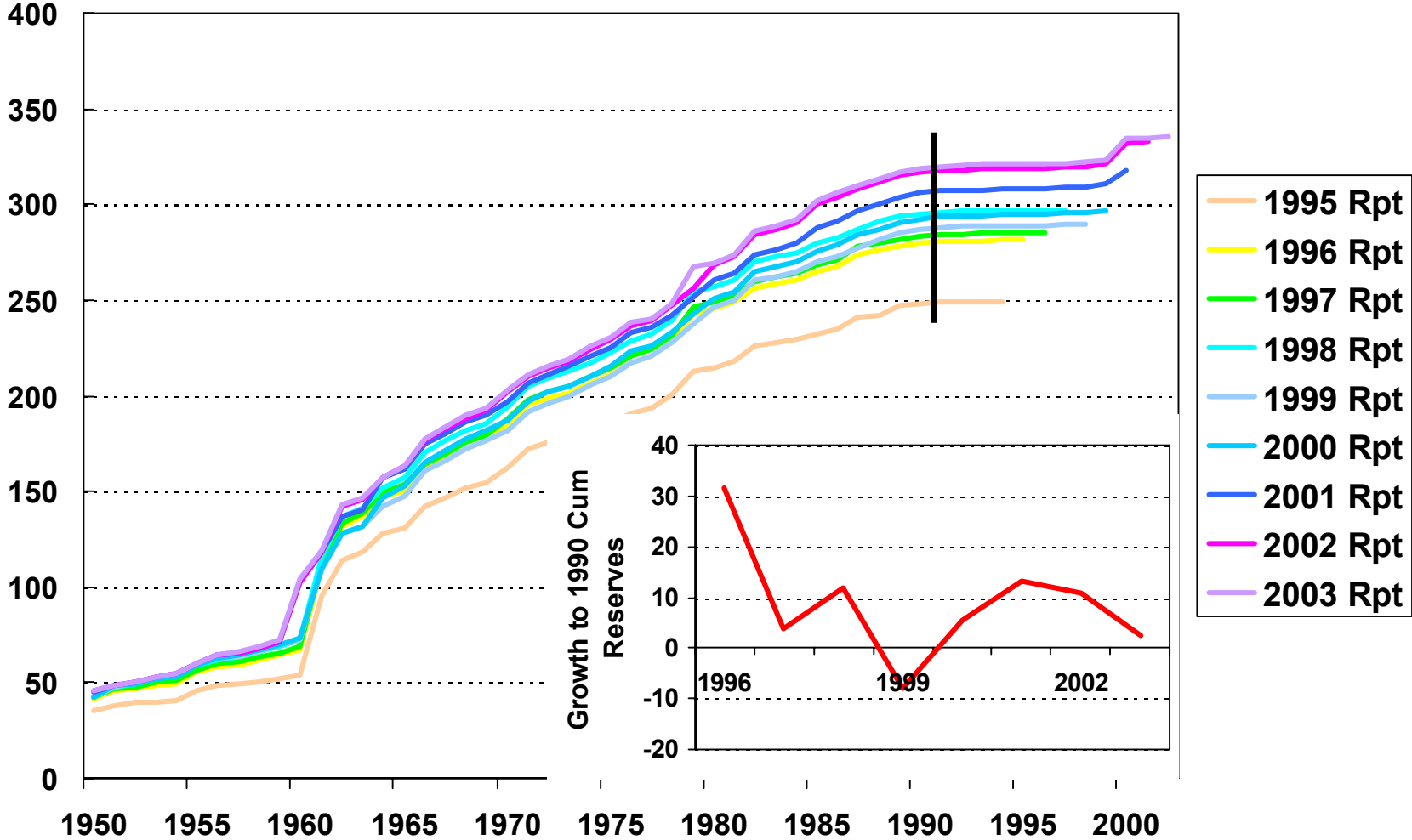
Data from IHS Energy and OGJ annual reports

# Growth in IHS Original Reserves – World



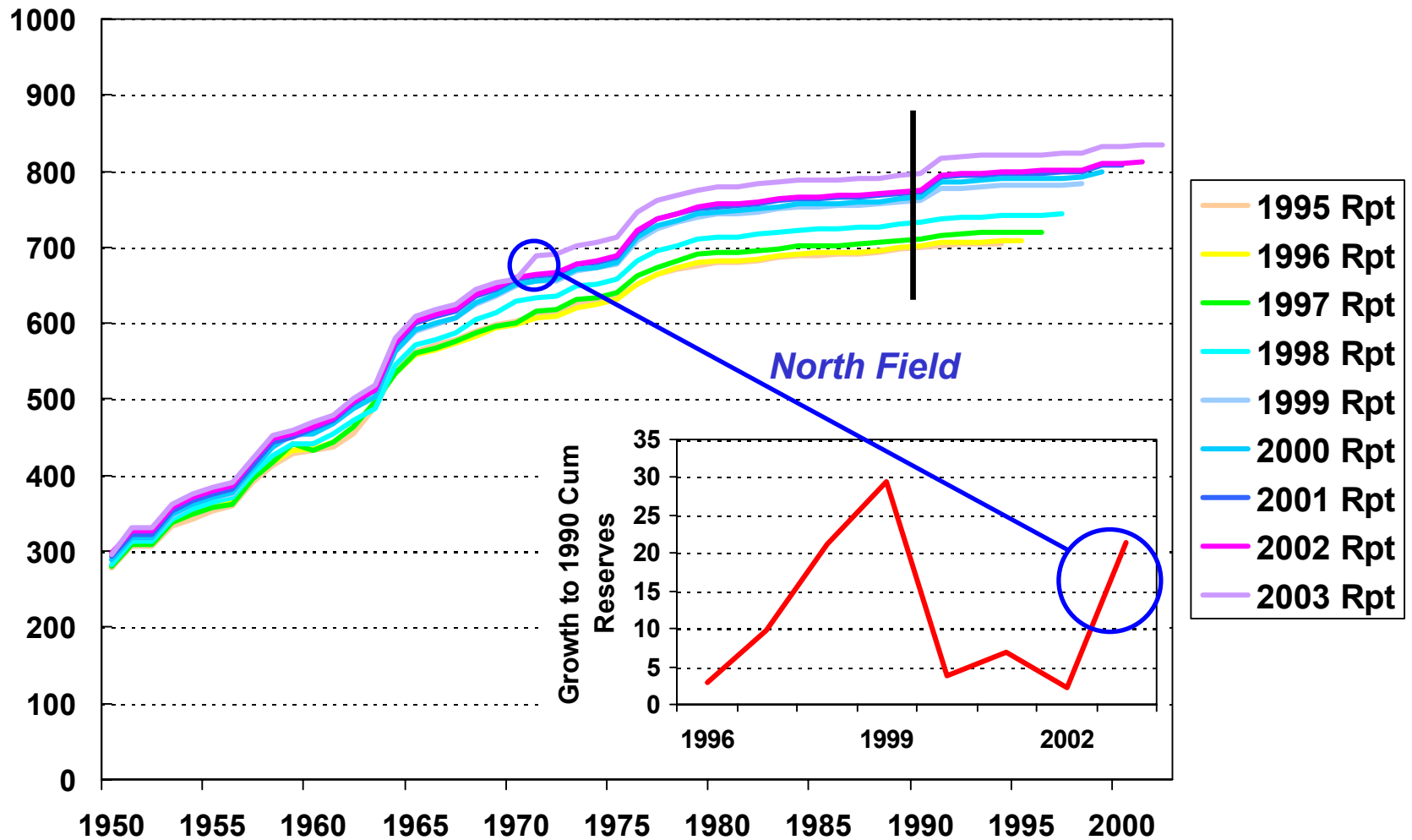
Data from IHS Energy annual reports

# Growth in IHS Original Reserves – FSU



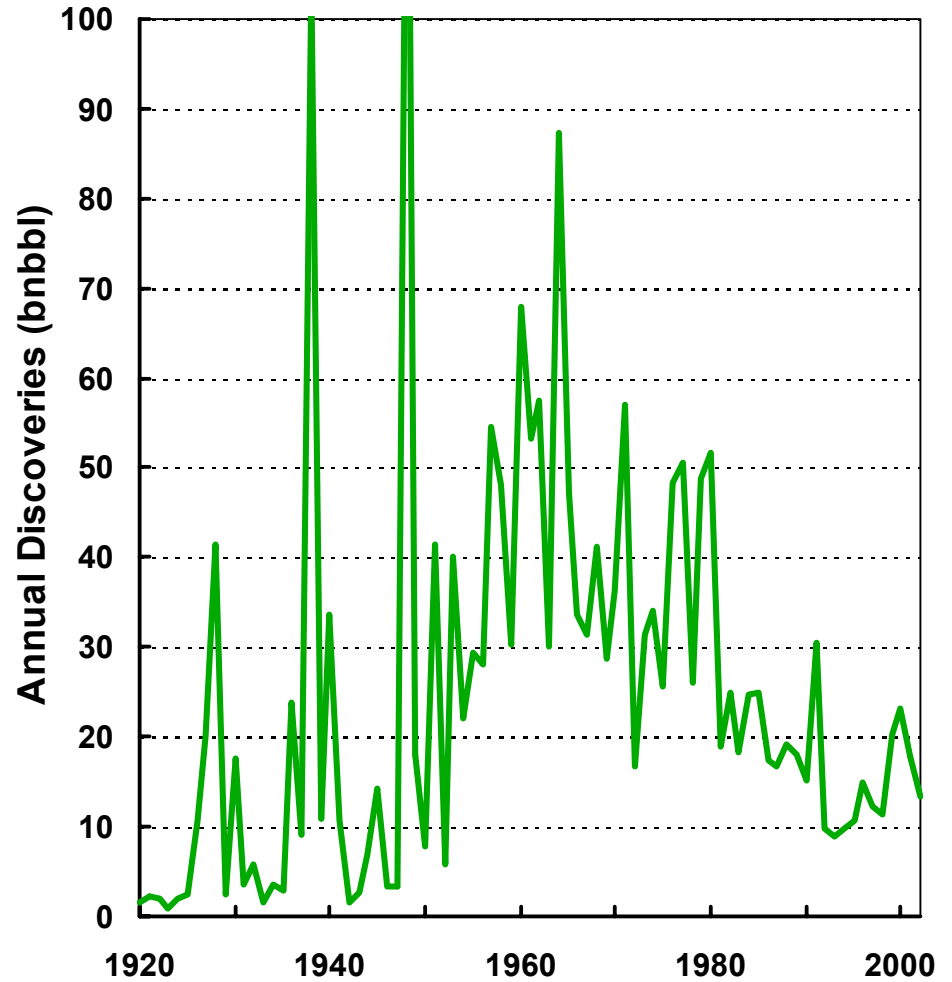
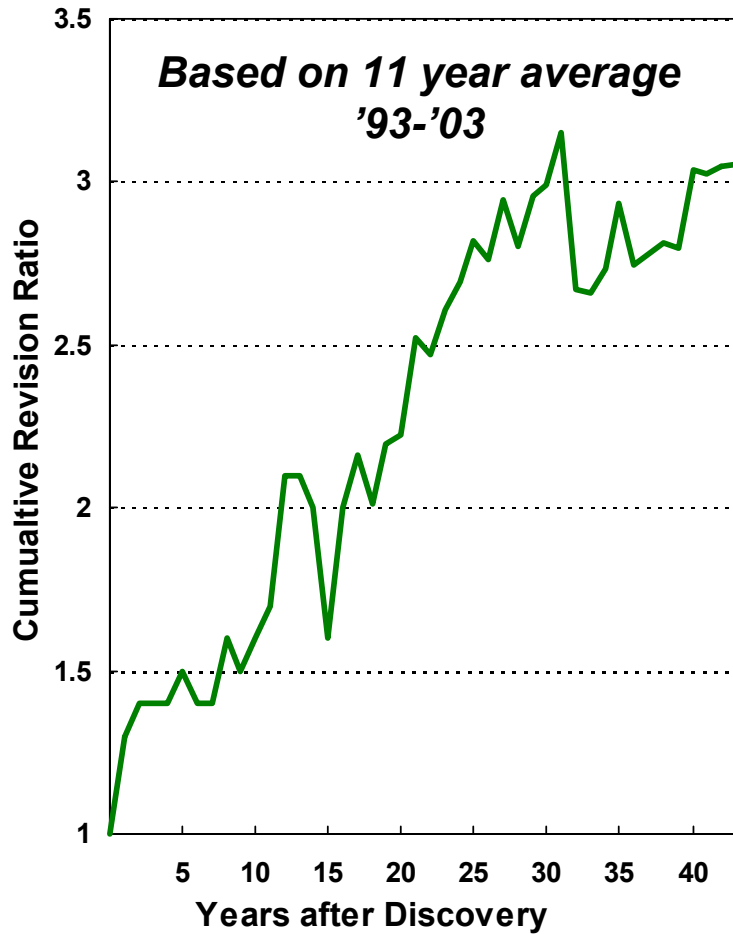
Data from IHS Energy annual reports

# Growth in IHS Original Reserves – MidEast



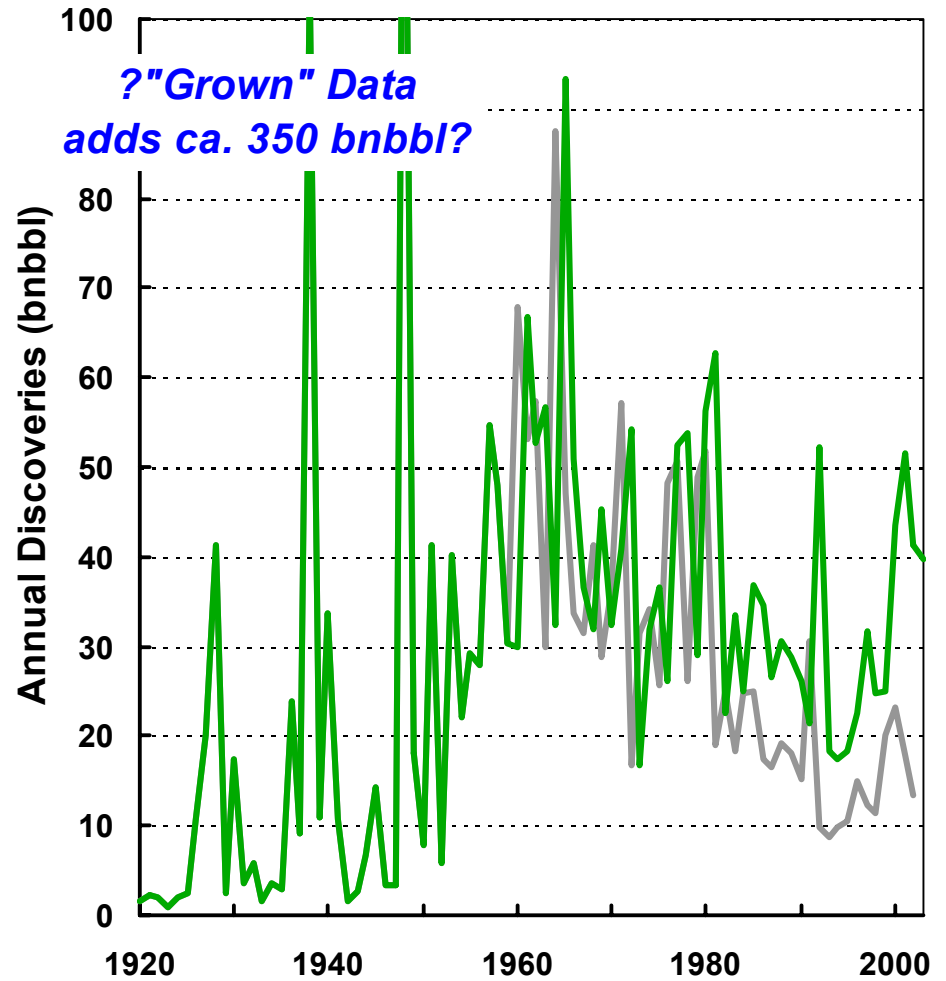
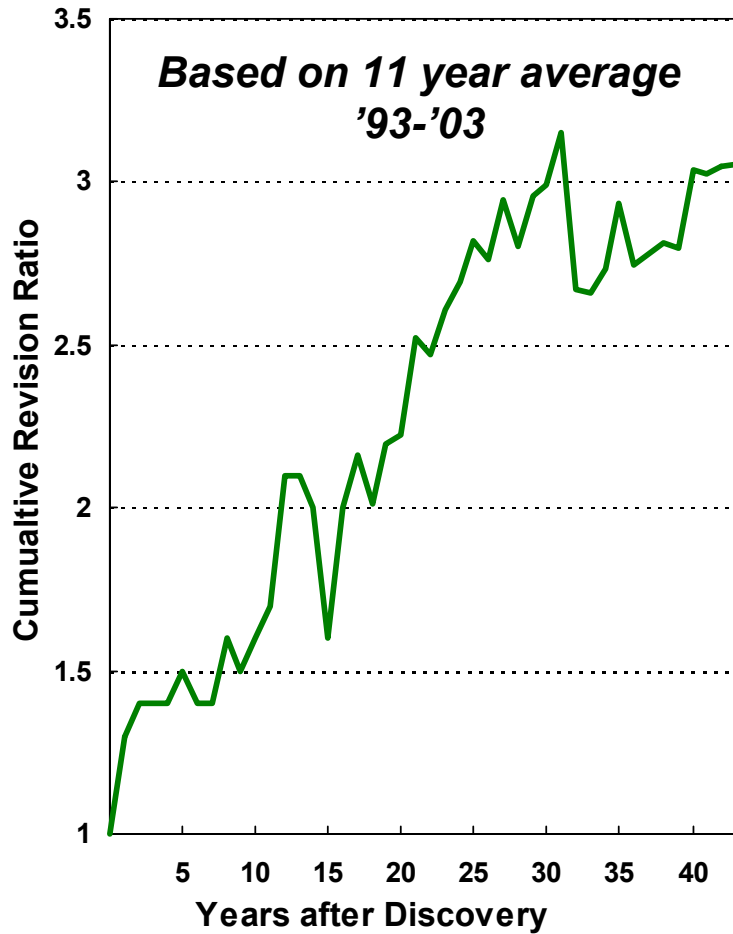
# Growth in Global Oil Reserves

## Arrington approach



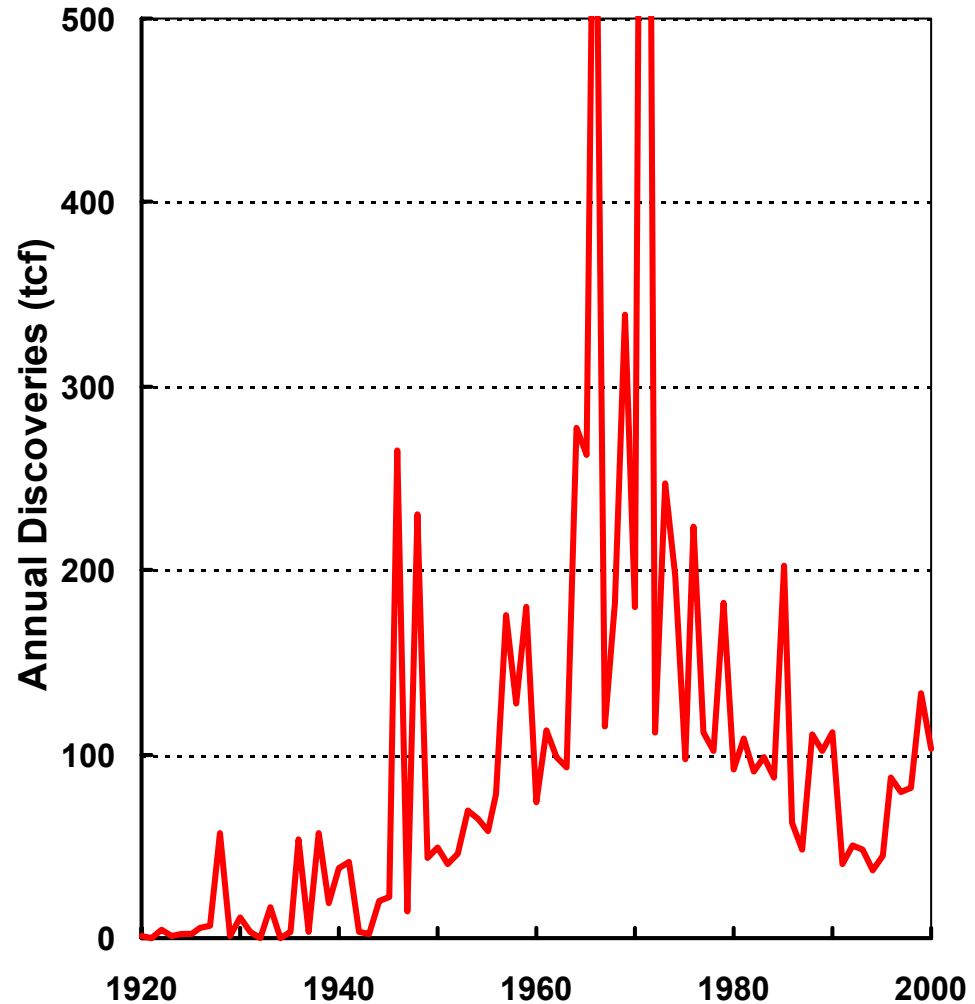
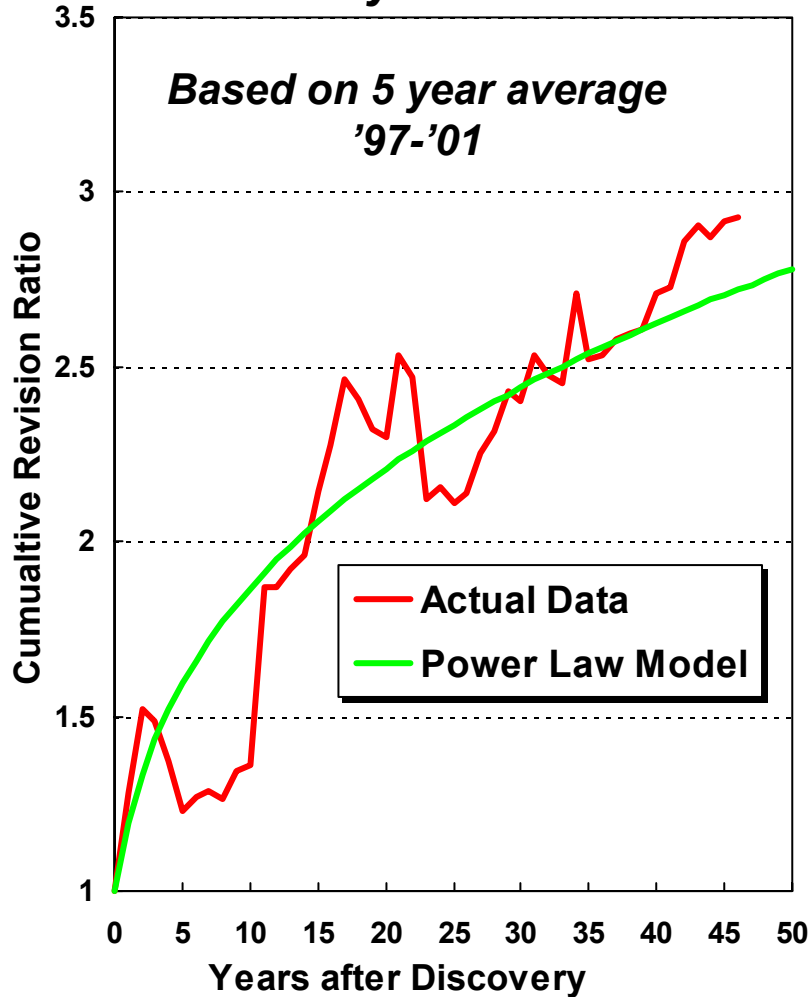
# Growth in Global Oil Reserves

## Arrington approach



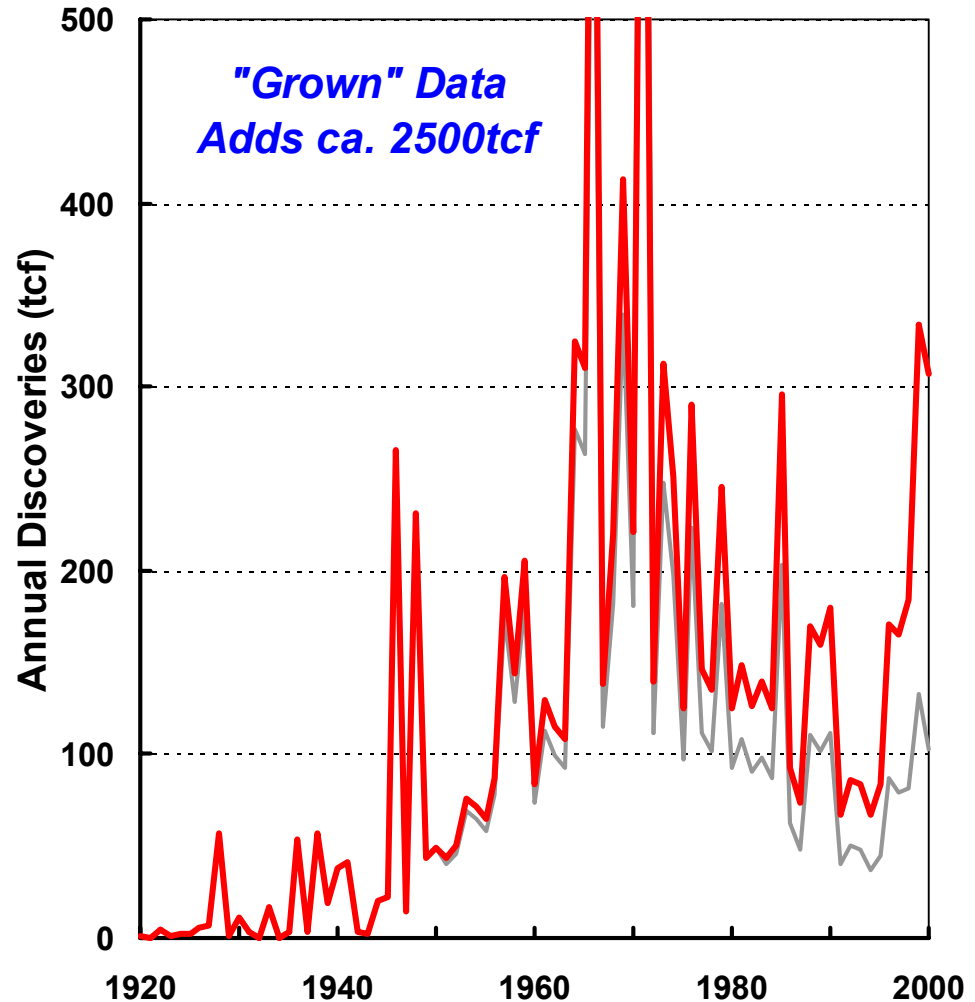
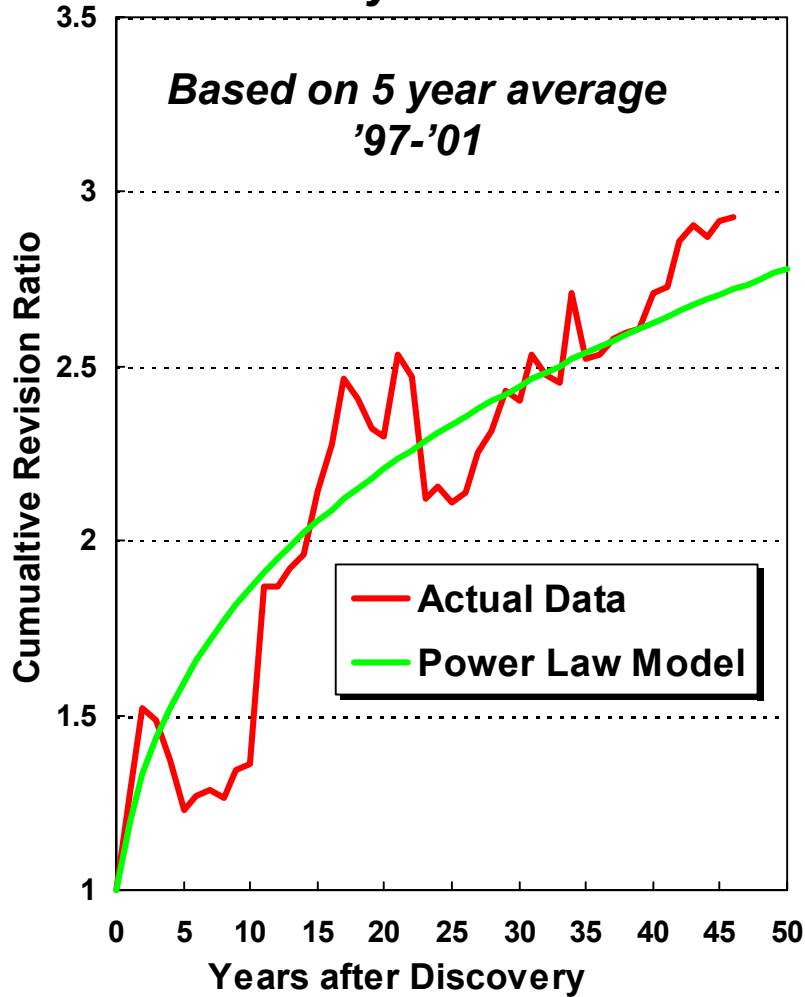
# Growth in Global Gas Reserves

*Analysis in 2001*



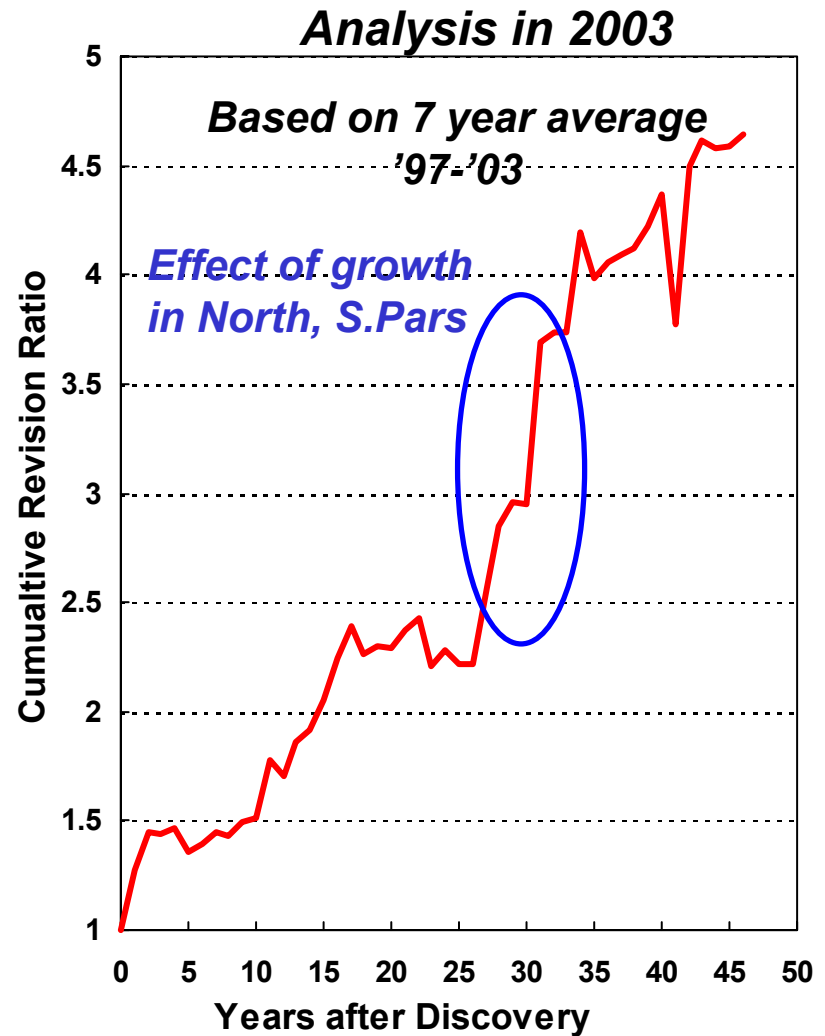
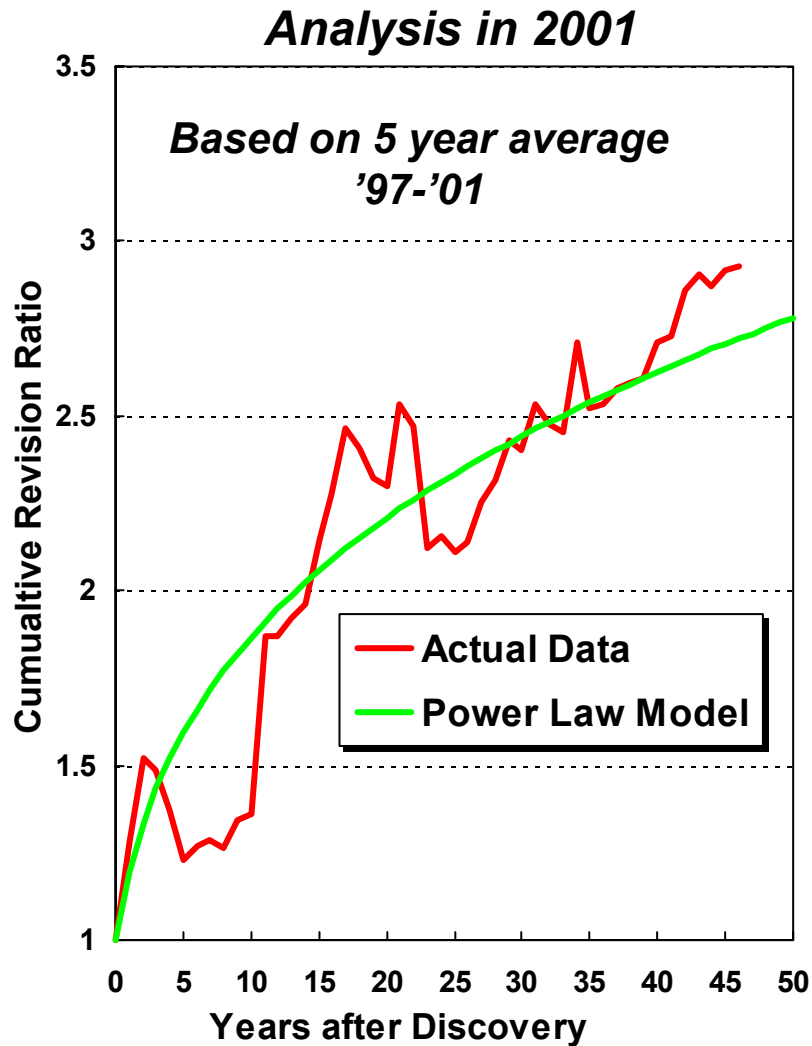
# Growth in Global Gas Reserves

*Analysis in 2001*





# Growth in Global Gas Reserves



# Conclusions

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- **Reserves estimates are uncertain and can vary widely throughout field life.**
- **There is a general tendency for reserve estimates to grow; this is true both for 2P reserves where the primary driver may be technological development and increased spend and for proved reserves where an additional driver may be reporting conservatism.**
- **Growth functions for any reserves dataset should be derived from within that dataset and should not be applied to others.**
- **Growth occurs by a combination of adding new oil-in-place and increasing recovery factor (and by under-reporting/back-booking for groups of fields)**
- **Growth is measured by comparing forecast and actual or by tracking annual estimates of historical discoveries.**
- **Reserves growth is a potentially important component of the oil resource but its magnitude is poorly known.**